



Neuromuscular diseases: professional parents and patients

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Guidebook for NMDs professional parent or patient



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Table of contents:

Part A. Introduction to NMDs Professional Parent or Patient “NMD-PRO

A.1. Background	3
A.2. Motivation for NMDs Professional Parents or Patients	3
A.3. Aims and objectives	4
A.4. Target groups	4
A.5. What is a NMDs Professional Parent or Patient?	5

Part B. Manual for NMDs Professional Parent or Patient

*Background Knowledge – what the NMD-PRO parent/patient needs
to understand to participate in a NMD-PRO Session*

B.1. The neuromuscular disorders NMDs	
1.1. General Description	6
1.2. Medical History and Symptoms	7
1.3. Physical Examination	9
B.2. Main types of neuromuscular disorders	
2.1. Diseases of Skeletal Muscle - Muscular dystrophies (MD) – Dystrophinopathies (Duchenne and Becker MD)	12
2.2. Diseases of the Neuromuscular Junction - Myasthenia Gravis and other syndromes	13
2.3. Diseases of the Peripheral Nerve - Charcot-Marie-Tooth (Hereditary Motor and Sensory Neuropathy)	15
2.4. Diseases of the Anterior Horn Cell - Spinal muscular atrophy (SMA) and Amyotrophic lateral sclerosis (ALS)	17
B.3. Parent’s guide to live with child’s neuromuscular disorder	
3.1. Introduction	19
3.2. Psychosocial issues for parents	19
3.3. The diagnosis implications in child’s development and behavior	22
3.4. Caring for your child	24
3.5. Issues about your family and child’s future	26
B.4. Useful Contacts	27

Appendix : Stretches, Correct Posture and Splints	28
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PART A. INTRODUCTION TO NMDS PROFESSIONAL PARENT OR PATIENT “NMD-PRO”

A.1. BACKGROUND

The “Neuromuscular diseases: professional parents and patients (NMD-PRO)” is a project working to be a support and information group for parents, patients, and staff who work with children/adults disabled by neuromuscular diseases (NMDs).

The project is supported by the Grundtvig Programme. The objective of this project is to raise and train educative/social/health knowledge and competencies for affected parents or NMD adult patients and transfer these competencies from them to caregivers, for all become a kind of education providers: ‘NMD professional parents and patients’. It is an innovative approach in which teachers/learners are both people with personal experience of NMD and care/education specialists.

Patients and parents of NMD diagnosed children often describe their long experience in what the sanitary system should provide (and it not provide), with what parents meet to cope with this reality, and the critical importance of inclusion as their children grow up. Moreover, in some European countries are not implemented yet, the Care Standards for NMDs, and still are problems regarding social inclusion and accessibility for disabled people (public transport, general public services, restaurants & hotels, universities & schools, working places, sport events and cultural events).

This education manual is aimed at the NMDs parents or adult patients who are going to be trained to be Professionals and teach to medical/social providers (students, teachers, health and social care professionals) about their needs/knowledge or to negotiate the individualized education, rehabilitation and health care programs.

A.2. MOTIVATION FOR NMDS PROFESSIONAL PARENTS OR PATIENTS

When an infant or young child is diagnosed with a disability, the family's lives are changed forever. Neuromuscular diseases (NMD) and the consequent disability affect the whole family and can create severe physical, emotional, social and financial strains. Parents and families have to adjust to a life different than they imagined. The ability of the family to meet these challenges is determined, in large part, by the support that is available from other immediate family members, grandparents, relatives or friends. We believe that sharing knowledge, problems and solutions with health care professionals, teachers, social workers and other parents in similar situations, by promoting the “parent-to-parent approach”, can help make life easier. By coming together as a group throughout Europe we’ll be able to talk to each other, share our experiences and advice, and the experiences and knowledge of others.

Advocacy organizations report variable and inconsistent social and health care for individuals with NMD or DMD. Practitioners will need more information about basic genetics, genetic counseling, supports and therapies for particular disorders, as families will be searching for this kind of information. This knowledge no longer belongs solely to the professionals. The parents and patients may know more than most professionals about their child’s specific genetic disorder. We must see their role to be that of educating service providers about what they have learned. In effect, they are ‘‘citizen scientist’’ who share

authoritative knowledge with service providers and expect to be partners in decisions affecting their children.

The new role of parents, patients and practitioners as "learning advisers" (and the skills needed to fulfil this) will be promoted through this Project. This role may be a crucial means of support to enable those who are excluded to reengage in learning. Learning advisers can also play an important part as advocates and comprehensive education suppliers.

Although specific treatments for neuromuscular diseases (NMD) or DMD have not yet reached, the natural history of the disease and life quality can be changed by the targeting of interventions to known manifestations, complications, therapies, social and physical rehabilitation. To reach these objectives it is necessary a multidisciplinary approach to caring for patients with NMD in which patient and family should actively engage with the medical professionals who coordinate clinical care. It is a crucial need to create the "multidisciplinary team care" consisting of educational, social and healthcare specialists that includes the parents and patients which have to develop the individualized education, rehabilitation and health care programs.

It is compulsory to operationalize the "family-centered care" philosophical constructs (e.g. families and professionals share decision making, professionals use a strengths-based approach when working with families) and use these constructs to critique and strengthen practices, programs, or policies that affect NMD population groups.

A.3. AIMS AND OBJECTIVES

The overall objective of the NMD-PRO Project is to support, train and raise educative/social/health knowledge and competencies for affected parents or NMD adult patients and transfer these competencies from them to caregivers, for all become a kind of educating service providers: "NMD professional parents and patients".

The project is supported by the Grundtvig Programme. It started in August 2011 and will end in July 2013. During that period we have organized five Transnational Meetings and four Workshops where we have trained groups of parents, patients, students, care workers to become more knowledgeable in neuromuscular disorders.

Other Project's objectives were to identify, share and exchange best practices and activities in which each partner has experience regarding social inclusion of neuromuscular disabled people, to introduce the concepts of "family-centered care", "multidisciplinary team care", and "parent-to-parent approach" and their fundamental role in facilitating education, rehabilitation, health care, social programs, to improve intercultural competencies, learning and training opportunities used in the member countries and organizations, and to contribute to European priorities such as social regeneration, health, family learning.

A.4. TARGET GROUPS

The specific target groups of the project are parents and NMD adult patients, teachers, health and social care professionals, volunteers. This project introduces an innovative approach in which the teachers/learners are both people with personal experience of NMD and care professionals. The learners ("pupils") are the members of the parent associations in UK and RO, employees/trainees and volunteers of IT institution, academics, postgraduate students and learners of RO and LV institutions, the social/professional partners in RO, IT, UK and LV.

UCV RO has used the project activities and outcomes in theoretical/practical activities for the professional training of postgraduate kinetherapists, teachers, social workers, sports

instructors. Thus, innovative methods and techniques were implemented in the postgraduate Pediatric Rehabilitation and Occupational Therapy courses and in the continuing kinesiotherapists education.

PP RO and AD UK have integrated the project activities/outputs into their parents' trainings and adult patients, in their current social, advocacy, clinical, educational programs and campaigns.

FOR IT has integrated the project activities in to activities of family training of patients both children and adults with neuromuscular disabilities and volunteers training (professionals and citizens tending NMD disabled).

UEC LV has integrated project's learning activities into its current training courses in European diversity education and inclusive approaches for teachers, teachers trainers, educational guides and counsellors, headmasters, school policy makers, psychologists.

A.5. WHAT IS A NMDs PROFESSIONAL PARENT OR PATIENT?

A NMD-PRO parent/patient is a person with personal experience in NMDs who is also an educator / a kind of professional who can tell about their conditions and how is to live with it.

The NMD-PRO patient/parent will also work in the future together with the health/social care sectors. He will take part in different kinds of educational settings. These could be at a medical/social centre, or at a course for health care staff, psychologists, social workers etc. for continuing professional development.

PART B. MANUAL FOR NMDs PROFESSIONAL PARENT OR PATIENT

Background Knowledge – what the NMD-PRO parent/patient needs to understand to participate in a NMD-PRO Session

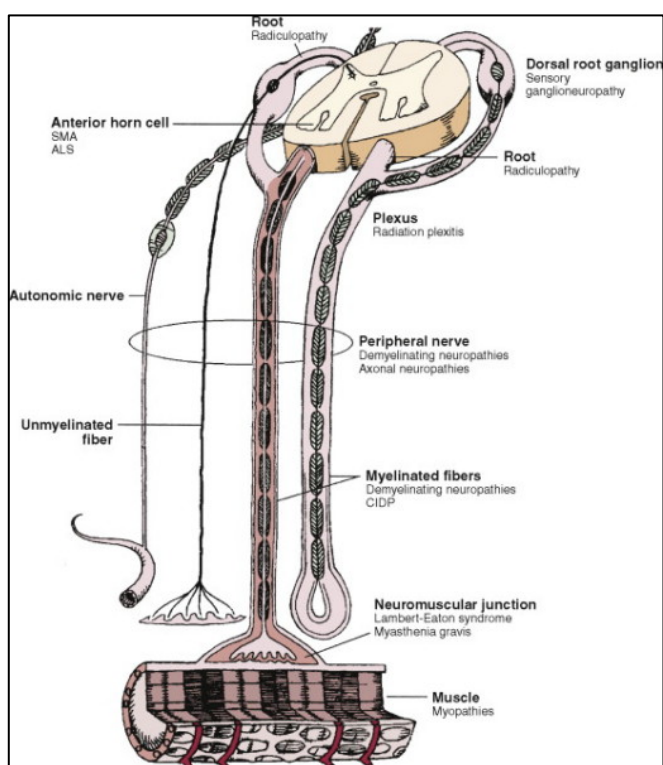
B.1. THE NEUROMUSCULAR DISORDERS (NMDs)

1.1. General Description

Neuromuscular disorder is a disability that results in a progressive loss of neurological, muscular, cardiac, respiratory, endocrine, digestive, and/or other major body systems (MDA, 2007). Most neuromuscular diseases involve some level of progressive muscle weakness or deterioration resulting in limited or devastated voluntary movement.

The appearance of symptoms and diagnosis of a neuromuscular disease can occur at any time during the lifespan, from infancy through adulthood. Some neuromuscular diseases are associated with rapid progression of symptoms and result in early death. This is true of several neuromuscular diseases that are typically diagnosed during infancy and early childhood.

Figure 1 Anatomic elements of the peripheral nervous system and related neurologic disorders. ALS, amyotrophic lateral sclerosis; CIDP, chronic inflammatory demyelinating polyneuropathy; SMA, spinal muscular atrophy.



This chapter is dedicated to the evaluation and treatment of neuromuscular disorders (NMDs), which include those that affect the anterior horn cells, nerve roots, plexi, peripheral nerves, neuromuscular junction, and muscles (Fig. 1). These disorders may be caused by genetic defects or may be acquired, as in autoimmune diseases; they also may be secondary to

general medical conditions or may arise as complications of surgery. To make therapeutic decisions about these disorders, clinicians should be able to recognize their clinical presentation and characteristics. This chapter provides a brief introduction to the evaluation of patients with NMDs.

1.2. Medical History and Symptoms

The evaluation should include obtaining **detailed medical and family histories** as well as identifying possible complicating factors. In children, information should be obtained on the prenatal period and delivery, especially if the patient was a “floppy baby,” and details of the patient's developmental milestones should be recorded.

Identifying general medical problems is important because some NMDs are associated with other conditions, such as, for example, endocrine and connective tissue diseases. Medications also should be considered, because many are known to produce neurologic complications.

Muscle weakness is a common symptom, except in patients with sensory or autonomic neuropathy or in some radiculopathies and entrapment syndromes. The **rate of progression varies**, and in some conditions, such as Guillain-Barré syndrome (GBS), electrolyte imbalance, toxic neuropathy, and myopathy associated with rhabdomyolysis, it is rapid (Box 1-1). In disorders of neuromuscular transmission, such as myasthenia gravis (MG), weakness fluctuates during the day. In periodic paralysis, weakness is recurrent, whereas in other disorders, such as muscular dystrophies, or in hereditary and some autoimmune neuropathies, it is subacute or chronic (Box 1 and 2).

Box 1

Neuromuscular Disorders That May Present with *Acute Generalized Weakness*

Motor Neuron Diseases

Poliomyelitis
Amyotrophic lateral sclerosis (rarely)

Neuropathies

Guillain-Barré syndrome and variants
Porphyria, particularly acute intermittent
Dinoflagellate toxins
Diphtheria
Arsenic poisoning and other acute toxic neuropathies

Disorders of Neuromuscular Transmission

Botulism and other biologic toxins (black widow spider bites, snake bites)
Organophosphate poisoning
Eaton-Lambert myasthenic syndrome
Hypermagnesemia
Myasthenia gravis

Myopathies

Rhabdomyolysis (from various causes, including metabolic, toxic, and infectious)
Polymyositis/dermatomyositis
Infectious myositis (e.g., trichinosis, toxoplasmosis)
Electrolyte imbalance (e.g., hypohyperkalemia, hypermagnesemia, hypocalcemia, hypercalcemia, hypophosphatemia)
Hyperthyroidism
Toxins

Intensive care myopathy (after immobilization with paralyzing agents and steroids in the intensive care unit)

Box 2

Examples of Conditions That Present with *Progressive Subacute or Chronic Proximal Muscle Weakness*

Progressive spinal muscular atrophy
Bulbospinal muscular atrophy (Kennedy disease)
Amyotrophic lateral sclerosis (sometimes)
Chronic inflammatory demyelinating neuropathy
Eaton-Lambert myasthenic syndrome
Myasthenia gravis
Endocrine diseases (e.g., hypothyroidism, Cushing disease, hyperparathyroidism)
Drugs (e.g., steroids, cholesterol-lowering agents, zidovudine, colchicine, chloroquine)
Toxins (e.g., alcoholic myopathy)
Electrolyte imbalance
Congenital myopathies (usually of earlier onset)
Muscular dystrophies
Polymyositis and dermatomyositis
Inclusion body myositis
Adult “nemaline” or “rod” myopathy
Mitochondrial myopathy
Juvenile and adult forms of acid maltase deficiency
Carnitine deficiency

The **distribution of weakness** also is important in diagnosis; for example, it is proximal in spinal muscular atrophies and most myopathies, except for some rare disorders in which it is more distal. In myopathies, weakness usually is symmetric, although asymmetry can be seen in some cases, as in fascioscapulohumeral dystrophy. In polyneuropathies, this characteristically begins in the legs, but may initially manifest more prominently in the upper extremities, as in multifocal neuropathy, brachial plexopathies, and cervical spinal canal disorders as well as in amyotrophic lateral sclerosis (ALS). This follows the territory of roots or nerves in radiculopathies and focal neuropathies.

Dysphagia, diplopia, and droopy eyelids also help to identify NMDs because they occur in some myopathies and also in disorders of neuromuscular transmission, such as MG. Symptoms of **respiratory difficulty** should be recognized and treated promptly because this can be the first manifestation of a disorder such as MG, GBS, ALS, and myopathies, such as acid maltase deficiency, whereas in other disorders, it appears at later stages.

Difficulty combing the hair and placing objects in high cabinets commonly occurs in patients with shoulder-girdle weakness, whereas **difficulty writing and grasping objects** indicates involvement of the forearm and hand muscles, as in ALS and inclusion body myositis.

Weakness of the hip extensors usually causes inability to rise from a low chair or a toilet seat, whereas difficulty ascending stairs indicates *dysfunction of the hip flexors and quadriceps* muscles. More severe weakness of the quadriceps muscles occurs in inclusion body myositis, causing difficulty descending stairs.

When the distal muscles are affected, **foot drop** may cause a steppage gait and difficulty negotiating curves or changing courses, as seen in polyneuropathies, distal dystrophies, and ALS.

Muscle stiffness, tightness, and spasms occur as a result of spasticity in disorders affecting the upper motor neuron, but these also occur in patients with motor unit hyperactivity, such as “stiff-person” and Isaac syndromes or the myotonias. Those with inflammatory myopathies, polymyalgia rheumatica, fasciitis, and hypothyroidism also complain of **stiff limbs**.

Cramping at rest or during exercise is a prominent symptom of cramp-fasciculation syndrome and also some neuropathies. In metabolic myopathies, this usually occurs during or after exercise, or after fasting in some cases.

Fatigue is common in disorders of neuromuscular transmission, such as Eaton-Lambert syndrome (ELS) and MG, but also in myopathies, even though weakness is the major symptom. In ELS, there may be temporary improvement after brief exercise.

Numbness and decreased sensation as well as **paresthesias and neuropathic pain** are symptoms of peripheral neuropathies. These symptoms are localized in the affected areas in those with radiculopathies, plexopathies, and entrapment neuropathies.

Autonomic dysfunction can occur in some neuropathies and also in ELS.

1.3. Physical Examination

A careful **general physical examination** is essential to arrive at a diagnosis, and the clinician should assess cardiac and lung function, examine the eyes for cataracts and retinal disease, and check for hearing loss, which is often seen in mitochondrial disorders. Visceromegaly and skin changes are present in some patients with neuropathies, for example, those with POEMS (*polyneuropathy, organomegaly, endocrinopathy, monoclonal gammopathy, skin changes*) syndrome. Skin abnormalities can also be seen in connective tissue disorders, whereas patients with dermatomyositis have a characteristic rash.

Intellectual function should be assessed because it could be impaired in some diseases, such as in some cases of ALS and in myotonic dystrophy.

During the **neurologic examination**, posture and muscle strength should be evaluated to determine, for example, whether there is hyperlordosis with proximal atrophy in myopathies or distal atrophy in neuropathies, whether it is symmetric or focal, or whether it affects the upper or lower extremities more prominently. The clinician should examine the patient for muscle hypertrophy, which is seen in some dystrophies and disorders of neuromuscular hyperactivity. Examination of muscle tone also is important to determine whether there is focal or generalized hypotonia, particularly in infants (Box 3).

Gait analysis includes observation for the characteristic waddling of myopathies, the circumduction of spasticity, the steppage gait of peripheral neuropathy and distal dystrophies, and the ataxic gait in those with spinal cerebellar degeneration or neuropathies causing prominent proprioceptive deficits that could also cause a positive Romberg test.

Examination of the eyelids and eye movements is helpful to diagnose acute paralysis in diabetic ophthalmoplegia and Miller-Fisher syndrome or chronic paralysis in mitochondrial myopathy and oculopharyngeal dystrophy. Fluctuating ophthalmoplegia and ptosis are seen in MG.

Prominent facial weakness occurs in GBS, but also in MG and some dystrophies. A decreased or hyperactive gag reflex, as in ALS, not only might provide help in the diagnosis, but also might determine the risk of aspiration. Tongue atrophy and fasciculations are characteristically seen in motor neuron diseases, whereas a typical forked tongue occurs in MG.

Examination of the neck muscles helps to identify neck extensor muscle weakness causing head drop disorders.

The examination should also include observation for fasciculations, which are more common in motor neuron disorders, but also are seen in some neuropathies, such as multifocal motor neuropathy. Increased reflexes with the presence of the Babinski sign indicate involvement of the corticospinal tracts, as in ALS, whereas generalized hypo- or areflexia is seen in peripheral neuropathies and some neuromuscular transmission disorders, such as ELS and botulism.

Box 3

Causes of Floppy Infants

Central Nervous System Disorders

Cerebral palsy

Mental retardation from primary metabolic disorders

Mixed (Central and Peripheral)

Metachromatic leukodystrophy and other lipidosis

Neuroaxonal atrophy

Giant axonal neuropathy

Merosin-deficient muscular dystrophy, other congenital muscular dystrophies (e.g., Fukuyama type)

Anterior Horn Cell Diseases

Infantile spinal muscular atrophy

Neuropathies

Charcot-Marie-Tooth disease, particularly types 3 and 4

Diseases of the Neuromuscular Junction

Congenital myasthenic syndromes

Infantile botulism

Neonatal transient autoimmune myasthenia gravis

Myopathies

Infantile metabolic myopathies (e.g., acid maltase deficiencies or Pompe disease, infantile phosphorylase deficiency)

Congenital muscular dystrophy

Other congenital myopathies (e.g., central core disease, myotubular myopathy, nemaline myopathy)

Congenital myotonic dystrophy

Myopathy from electrolyte and endocrine abnormalities

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seen in peripheral neuropathies and some neuromuscular transmission disorders, such as ELS and botulism.

Distal reflexes are lost early in neuropathies and are preserved until the later stages in myopathies (Table 1).

Table 1 - Neuromuscular Disease: Clinical Evaluation

Clinical Parameter	Motor Neuron Disease	Polyneuropathy	Myopathy	Diseases of Neuromuscular Junction
Pattern of weakness	Variable, symmetric in most, often asymmetric in ALS	Distal > proximal	Proximal > distal; fluctuates; often involves extraocular muscles	Proximal distal in most
Fasciculations	Yes	Sometimes	No	No
Muscle stretch reflexes	Variable, decreased in most, increased in ALS	Decreased or absent	Normal in postsynaptic disorders (myasthenia gravis), decreased in presynaptic disorders (Eaton-Lambert syndrome and botulism)	Normal initially, may be decreased in later stages (ankle reflexes often preserved until very late)
Sensory loss	No	Usually present	No	No

The sensory examination helps to determine the type and distribution of deficits to determine whether they are distal, symmetric, or follow the dermatomes of nerve roots or individual nerves, and whether they affect more severely the large myelinated axons (proprioceptive deficits), the unmyelinated axons (dysautonomia, pain, and temperature deficits), or both.

B.2. MAIN TYPES OF NEUROMUSCULAR DISORDERS

2.1. Diseases of Skeletal Muscle - Muscular dystrophies (MD) – Dystrophinopathies (Duchenne and Becker MD)

Duchenne and Becker muscular dystrophies

Duchenne muscular dystrophy (DMD) and Becker muscular dystrophy (BMD) are X-linked recessive disorders that primarily affect skeletal and cardiac muscle.

Dystrophin, a large cell wall (sarcolemma) structural protein, is absent in DMD and of abnormal molecular weight or of reduced amounts in BMD. Dystrophin stabilizes the sarcolemma during muscle contractions. Without dystrophin, the sarcolemma is unstable, cell homeostasis is impaired, and the myofiber ultimately deteriorates. Despite some regeneration, repair capacity is rendered insufficient, and the muscle is replaced by fat and connective tissue.

DMD is the most common childhood NMD, with an estimated overall prevalence of 63 cases per million population. This myopathy is progressive and ultimately fatal, with death usually occurring in people younger than 30 years. Life expectancy has risen considerably over the past decade because of better management of respiratory or cardiac complications. Only a few decades ago, boys with DMD rarely lived to be older than 20 years.

BMD is less common, with an estimated prevalence of 24 cases per million population. BMD is associated with the same muscle weakness that DMD is but has a much later onset age and a slower rate of progression. The abnormal gene for DMD and BMD is on the short arm of the X chromosome at position Xp21.

Myotonic muscular dystrophy

Myotonic muscular dystrophy (MMD) is clinically characterized by progressive, primarily distal muscle weakness and myotonia (delayed muscle relaxation). Patients with MMD typically have a characteristic facies, including frontal baldness and temporal wasting. Other problems include gonadal atrophy, cataracts, cardiac dysrhythmias, and an increased risk of diabetes. MMD is an autosomal dominant trait with a prevalence of 1 case per 8000 population.

Several forms of MMD exist, primarily because of the unusual genetic basis of the disease. MMD is caused by a DNA sequence within the gene on chromosome band 19q13.3 that is repeated to varying degrees, producing an expanded, unstable area of the chromosome. This abnormal gene, referred to as a triplet repeat mutation, may grow as it is passed from generation to generation. This can cause the disease to present earlier and more severely in passing generations in a family line.

The most severe form of MMD is known as congenital MMD. Patients with congenital MMD have been shown to have substantially more repeats than patients with typical MMD do. The repeated DNA sequences known as CTG (cytosine-thymine-guanidine) are linked to the production of myotonin-protein kinase, which has important functions in smooth and skeletal muscle, eye, hair, and brain, and decreased levels of the mRNA and protein expression.

Another form of MMD is known as type 2 MMD (MMD2 or DM2), also referred to as proximal myotonic myopathy. A mutation on chromosome 3 causes MMD2, which is thought to be clinically less severe than typical MMD and congenital MMD. MMD2 may be associated with insulin insensitivity, diabetes, and low testosterone levels in males.

Facioscapulohumeral muscular dystrophy

Facioscapulohumeral dystrophy (FSHD) is a slowly progressive myopathy with prominent involvement of shoulder, pelvic, and facial musculature. It is an autosomal dominant trait with an estimated prevalence of 10-20 cases per million population—possibly higher, if undiagnosed, mild cases are taken into account.

The abnormal gene is on the end of chromosome 4, and DNA testing for diagnostic purposes is now commercially available. FSHD can be quite heterogeneous in its clinical presentation and course; this raises questions regarding genetic homogeneity.

Limb-girdle muscular dystrophies

Limb-girdle muscular dystrophies (LGMDs) are a highly heterogeneous group of myopathies sharing many clinical features. The age of onset ranges from 3 to 12 years, with equal male and female prevalence. The distribution and pattern of weakness are similar to those of DMD, but progression is much slower. LGMDs have been linked to abnormalities of the dystrophin-associated glycoproteins (DAGs), especially alpha-sarcoglycan (adhalin, linked to the 17q12-q21.33 locus) and gamma-sarcoglycan.

Other forms of LGMD have been linked to chromosome band 13q12. Individuals with these forms may show a primary deficiency of gamma-sarcoglycan and a secondary deficiency of alpha-sarcoglycan.

People with LGMD generally have normal results on tests for dystrophin. All of the DAGs are reduced in patients with DMD because the C-terminal portion of dystrophin binds to the dystrophin-associated proteins and maintains their integrity. A less severe autosomal recessive form of LGMD has been linked to chromosome band 15q1-q21.1, the gene for the protein calpain 3. Diagnosis of all forms of LGMD subtypes is best confirmed based on muscle biopsy.

DAGs probably provide connections between the extracellular matrix (the protein merosin) and the intracellular membrane cytoskeleton (attached to dystrophin).

An abnormality of the dystrophin-glycoprotein complex, resulting from primary deficiencies of 1 or more of the DAGs, results in a disruption in the linkage between the intracellular sarcolemmal cytoskeleton and the extracellular matrix. Disruption of the membrane cytoskeleton is common to the pathophysiology of most muscular dystrophies (ie, the dystrophinopathies).

2.2. Diseases of the Neuromuscular Junction - Myasthenia Gravis and other syndromes

The neuromuscular junction is where the electrical signal causes neurotransmitters to be released from vesicles at the end of the nerve (the terminal). The neurotransmitters cross a small gap between the nerve terminal (the synapse) and the surface of the muscle (the endplate). Waiting for the transmitters on the other side of the gap are special receptors that fit the transmitter like a lock to a key. When there's a fit, a cascade of ions leads to muscular contraction.

Myasthenia Gravis

Myasthenia gravis is a disorder in which normal communication between the nerve and muscle is interrupted at the neuromuscular junction. Normally when impulses travel down the nerve, the nerve endings release a neurotransmitter substance called acetylcholine, which travels through the short neuromuscular junction and results in the activation of muscle contraction. In myasthenia gravis, the receptors for acetylcholine at the muscle surface are destroyed or modulated by antibodies that prevent the normal reaction from occurring. The antibodies are produced by the patient's own immune system, which is believed to generate an

aberrant autoimmune reaction resulting in an attack on the patient's own neuromuscular junction.

The symptoms of myasthenia gravis often consist of muscle fatigability with the patients complaining of worsening of symptoms later in the day after their muscles have been fatigued or after being repetitively exercised. The symptoms range from difficulty in eye motion which results in double vision or droopy eyelids, to diffuse weakness and fatigability in the arms and legs. Other symptoms may include fatigue of throat muscles, resulting in swallowing difficulties and choking, and/or fatigue of the muscles of speech, resulting in slurred and unintelligible speech. Myasthenia gravis does not affect bowel and bladder function or the patient's mental capacity.

When the diagnosis of myasthenia gravis is suspected tests will be needed for confirmation of the diagnosis. A tensilon test, which is a relatively simple procedure, involves insertion of a small intravenous catheter through which tensilon is administered. Tensilon is a very short-acting drug that blocks the degradation of acetylcholine, thus increasing its levels for a very short time at the neuromuscular junction. The increased availability of acetylcholine results in improved muscle function and thus a transient improvement of the patient's symptoms. The most dramatic response is usually seen in patients with ocular difficulties. Patients with complete closure of the eyelids may open the eyes fully, but transiently, after tensilon administration. A negative tensilon test, however, does not rule out the diagnosis of myasthenia gravis. The next diagnostic step is obtaining blood for detection of acetylcholine receptor antibodies which are present in about 85 to 90 percent of patients with myasthenia gravis. The final diagnostic step is an EMG and nerve conduction study.

The nerve conductions and EMG studies are usually normal in myasthenia gravis, but the repetitive stimulation of a nerve may demonstrate decrements of the muscle action potential. The muscle biopsy is usually not of diagnostic help in typical myasthenia gravis.

Once the diagnosis of myasthenia gravis is established, the patient and the treating physician will chart the appropriate therapeutic approach to the disease. Transient symptomatic control can be achieved by the initiation of Mestinon given orally. Mestinon is a medication that blocks the degradation of acetylcholine at the neuromuscular junction and provides for an increased level of acetylcholine and a better muscle response to stimulation by the nerve. Mestinon is a temporary symptomatic treatment and does not reverse the course of the illness. In most cases, the first step in altering the course of myasthenia gravis is surgical removal of the thymus gland (thymectomy). The thymus gland is located behind the sternum (breastbone) and is considered the "training center" for the immune cells in the body. All antibody-producing cells in the body have to pass through the thymus to be properly "educated" in the production of various antibodies. In myasthenia gravis, the thymus enhances the presence and the antibody production capacity of immune cells that produce antibodies against the neuromuscular junction receptor. Although the precise role of the thymus gland in myasthenia gravis remains obscure, several studies have suggested that a thymectomy increases the chances of the patient going into remission to more than 50 percent. The thymectomy will also facilitate the control of the symptoms of myasthenia gravis by requiring a smaller amount of medications than prior to surgery. The benefits for the symptoms of myasthenia gravis may not be noticed until about 6 to 18 months after the thymectomy.

Control of myasthenia gravis is provided by the use of various immunosuppressants. The most commonly used immunosuppressant is prednisone which is usually started at a high dose every day, and then reduced to a every other day regimen. The exact dose and mode of administration of prednisone must be tailored to the patient's need. Prednisone is a type of steroid and is often associated with several side effects. In the event of intolerable side effects or failure of treatment, other immunosuppressants may be used, most commonly Imuran.

Patients with myasthenia gravis, especially untreated, may develop a "myasthenic crisis." These crises can be triggered by excessive physical or emotional stress. A myasthenic crisis is a serious condition as the patient rapidly develops diffuse weakness, including weakness of the respiratory muscles which may temporarily require the use of mechanical ventilation. Under these conditions more aggressive treatment has to be implemented. The two most commonly used treatment regimens include several days of intravenous gamma globulin or several sessions of plasma exchange. Following resolution of the myasthenic crisis, the more conventional immune treatment is reinstated.

Congenital Myasthenic Syndromes (CMSs)

This group of disorders results from mutations in genes responsible for various components of the neuromuscular junction. With the exception of autosomal dominant slow channel syndrome, CMSs are inherited in an autosomal recessive manner. Age of onset, severity, and response to medications vary even among family members.

Infants may present with failure to thrive. Weakness of facial and bulbar muscles, high arched palate, history of affected relatives, decremental repetitive stimulation test, and negative AchR (acetylcholine receptor) antibodies should lead one to suspect CMS. Distinguishing clinical features of specific syndromes include sluggish pupillary light responses in some patients with endplate acetylcholinesterase deficiency, and weakness of cervical, wrist, and finger extensor muscles in slow channel syndrome.

Once a clear diagnosis is made, treatment options include pyridostigmine, 3,4-diaminopyridine (DAP) (available for compassionate use or research protocols), quinidine, and fluoxetine. Immunosuppressive and immunomodulatory treatments (thymectomy, Plasma exchange (PE) and intravenous immunoglobulin (IVIg) PE, and IVIg) are not helpful.

Eaton-Lambert Syndrome - Lambert-Eaton Myasthenic Syndrome

This disorder and its symptoms are quite different from myasthenia gravis, despite the similarity in name. It is found more frequently in men than in women and usually occurs after the age of 40.

Symptoms include weakness and tiredness around the hips and subsequent difficulty rising from a chair. It progresses to involve legs, shoulders and arms. Backache that improves as the day progresses and fatigue are also common symptoms. Exercise works to improve symptoms. Certain medications (3, 4 diaminopyridine) may also be of benefit. A correct diagnosis requires a careful EMG study by an expert familiar with the disease. The disease may be associated with some forms of cancer, particularly lung cancer. In these patients, it is thought that antibodies directed against the tumor also act against the nerve-muscle junction.

2.3. Diseases of the Peripheral Nerve - Charcot-Marie-Tooth (Hereditary Motor and Sensory Neuropathy)

Charcot-Marie-Tooth disease

Charcot-Marie-Tooth disease (CMT) can be divided into 2 basic types: primarily demyelinating (with secondary axonal loss) and primarily axonal. The remainder of the subclassification of CMT is based on genetic analysis.

In *CMT type 1* (CMT1), which is primarily a demyelinating neuropathy, anatomic changes directly affect the myelin sheath, with secondary axonal changes. In areas of focal demyelination, impulse conduction from one node of Ranvier to the next is slowed; current leakage occurs and the time for impulses to reach threshold at successive nodes of Ranvier is prolonged, producing slowing of conduction velocity along the nerve segment.

CMT type 2 (CMT2) is a primary axonal neuropathy producing changes in the axon and the nerve cell body. Clinically, CMT2 is often less severe than CMT1. Patients with

CMT2 may have more lower extremity involvement, although in other respects they may not be easily distinguishable from patients with CMT1. Most of the phenotypic descriptive studies in CMT were done before the advent of DNA testing.

Overall, CMT is a slowly progressive disorder characterized by diffuse muscle weakness and prominent distal atrophy, predominantly involving the intrinsic muscles of the feet and the peroneal muscles. Subjects with CMT produce 20-40% less force than normal controls on quantitative isometric and isokinetic strength measures, even though manual muscle test scores may be normal. No significant side-to-side difference exists with regard to strength. From a functional standpoint, the sensory deficit is usually less severe than the motor deficit.

Prior studies have also documented that subjects with CMT have a marked reduction in functional aerobic capacity during exercise testing, despite having normal or relatively normal preexercise pulmonary function, exercise heart rate, and blood pressure and maximum ventilation.

The number of molecular forms of CMT and related neuropathies is always growing. However, CMT1 is the most common type overall. CMT1A (see the image below) is the most common subtype of CMT1 and results from a duplication of chromosome segment 17p11.2, which contains the gene for peripheral myelin protein 22 (PMP22).

Notably, patients with a related disorder, hereditary neuropathy with liability to pressure palsies (HNPP), show a large deletion, rather than a duplication, in the *PMP22* gene. HNPP is an autosomal dominant disorder that produces episodic recurrent nerve compression with focal demyelination at common sites of compression or entrapment (eg, wrist, elbow, and fibular head). Nerve compression can occur in the absence of true entrapment.

CMT X is an X-linked dominant, primarily demyelinating neuropathy with a mutation in the connexin 32 gene (*CX32*), which codes for a membrane protein (gap junction protein, beta 1) involved in the formation of gap junctions. *CMT X1* is clearly a distinct entity. Some varieties of *CMT X1* may exhibit abnormal temporal dispersion and heterogeneous conduction velocities that are very atypical of other hereditary neuropathies.

Mutations in the *CX32* gene can produce a neuropathy with either demyelinating or axonal electrodiagnostic features. Some clinical and electrodiagnostic data in males with different missense mutations in the *CX32* gene appear to differ significantly. Furthermore, males with nonsense mutations have an earlier onset and a more severe phenotype than males with missense mutations.

Point mutations in *PMP22* or the myelin protein zero gene (*MPZ*) may cause *Dejerine-Sottas disease*. Thus, many cases of *Dejerine-Sottas disease* are now considered severe phenotypes within the genotypic spectrum of CMT1. Congenital hypomyelinating neuropathy is a severe and often fatal newborn disorder that presents with respiratory distress at birth and has been linked to the early growth response gene 2 (*EGR2*) in some families.

2.4. Diseases of the Anterior Horn Cell - Spinal muscular atrophy (SMA) and Amyotrophic lateral sclerosis (ALS)

Spinal muscular atrophy

All forms of spinal muscular atrophy (SMA) involve selective destruction of anterior horn cells. The distinct types of SMA differ clinically. Some rare forms affect only distal or bulbar muscles. SMA is usually classified as types I, II, and III. Most forms of SMA are autosomal recessive traits.

SMA I, also known as Werdnig-Hoffmann disease or acute infantile-onset SMA, is a severe disorder that causes death before age 2 years.

SMA II, also known as chronic Werdnig-Hoffmann disease or early-onset intermediate SMA, is less severe. SMA II may not become apparent until age 6-18 months.

SMA III, also known as Kugelberg-Welander disease, has a much later onset (typically, age 5-15 years) and is associated with much less morbidity.

Mutations in exons 7 and 8 of the telomeric survival motor neuron gene are present in more than 98% of patients with SMA types I-III. Deletions in the neuronal apoptosis inhibitory protein gene are found in about 67% of patients with SMA I, 42% of patients with SMA II or III, and some patients with adult-onset SMA, though the precise percentage is not known. Commercial blood tests (DNA analyses) are now available for use in diagnosing SMA. Prevalences for SMA types II and III have been estimated to be as high as 40 cases per million in the general population, though considerable variations exist in demographic studies.

Two forms of later adult-onset SMA exist. The first type is spinobulbar muscular atrophy (SBMA), or Kennedy disease. This disorder, which was first described as recently as 1968, is a sex-linked recessive NMD characterized by progressive spinal and bulbar muscular atrophy, gynecomastia, and reduced fertility.

SBMA has been mapped to the androgen receptor on the X chromosome. The mutation, which consists of an expansion of cytosine-adenine-guanine (CAG) trinucleotide repeats, occurs in the first exon of the gene, producing decreased sensitivity of androgen receptors on motor neurons. The disease has some clinical variability; however, phenotypic expression does not correlate with the length of CAG repeats.

In this way, SBMA differs markedly from myotonic muscular dystrophy and fragile X syndrome, in which an increased number of tandem triplet repeats correlates directly with disease severity. SBMA can occur without any family history or gynecomastia, and all males with atypical ALS should undergo DNA testing for SBMA (the DNA test is commercially available).

The other form of later adult-onset SMA has its onset in patients aged 17-55 years, with either recessive or dominant types of inheritance. This form of SMA clinically resembles SMA III but may be more progressive. It has been mapped to chromosome band 5q11.2-13.3; however, commercial testing is not yet available, because adult-onset SMA and SBMA are far less common forms of SMA.

Amyotrophic lateral sclerosis

Amyotrophic lateral sclerosis (ALS) is perhaps the most severe of all the major NMDs. It is a rapidly progressive NMD that destroys upper and lower motor neurons. This results in diffuse muscular weakness and atrophy. Unlike most primary nerve disorders, ALS also produces spasticity because of the loss of upper motor neurons. This creates unique clinical management issues.

An estimated 10% of all ALS cases are familial, usually inherited as an autosomal dominant trait. About 15% of these cases result from a gene defect on chromosome band

21q12.1, which leads to a mutation in the gene for the antioxidant enzyme Cu/Zn superoxide dismutase (*SOD1*). Approximately 100 *SOD1* mutations have been identified, and nearly all are single missense dominant mutations causing toxic gain of function. Over 50 unique superoxide dismutase mutations have been identified. Emerging evidence suggests that these mutations result in increased oxidative stress for the motor neurons, leading to cell death, which is presumably related to free radical toxicity.

However, most ALS cases occur sporadically, without a known cause. Studies suggest that an excess of the excitatory neurotransmitter glutamate in the central nervous system (CNS) is involved in the disease process. Serum, cerebrospinal fluid (CSF), and brain tissue of patients with ALS contain abnormally high levels of glutamate, apparently as a result of reduced clearance of glutamate from the motor cortex and decreased activity of glutamate transport proteins.

Population studies indicate that the prevalence of ALS is increasing, although this may be because of better recognition of the condition and increased longevity of people with ALS. The worldwide prevalence is 5-7 cases per 100,000 population, making ALS one of the more common NMDs.

ALS seems to affect men more commonly than it affects women, with a male-to-female ratio of approximately 1.5:1. It primarily affects adults aged 40-60 years, with a mean onset age of 58 years. A higher prevalence of ALS exists in urban areas, possibly due to environmental factors. Considerable geographic clustering has been seen in association with ALS, most notably in the Western Pacific region of the world, but also in Gulf War veterans. Despite clustering, environmental or causal factors remain to be determined. Dietary fat increased the risk for ALS, although alcohol consumption did not. Dietary fiber intake decreased risk, although consumption of antioxidant vitamins from diet or supplement sources did not alter the risk. Notably, glutamate consumption did correlate with an increased risk for ALS. That smoking and glutamate consumption are risk factors for ALS supports the theory implicating oxidative stress and excitotoxicity in the pathogenesis of ALS.

The major neuropathologic finding in ALS is the degeneration and subsequent loss of motor neurons as a consequence of apoptosis (programmed cell death). Apoptosis is characterized by neuronal contraction (to approximately one fifth the normal size) with an extremely condensed nucleus and cytoplasm. Apoptotic bodies can usually be seen in macrophages.

Other neuropathologic findings in ALS include axonal loss in the descending motor tracts, anterior roots, and nerves. There also appears to be subtle involvement of the frontal lobes, hippocampal area, substantia nigra, and dorsal columns.

Motor neuron degeneration begins focally and spreads to contiguous regions in the neuraxis until the neurons controlling respiration are affected, which ultimately leads to death from respiratory failure. The number of motor neurons involved and the spectrum of motor neuron degeneration varies for any individual patient, which accounts for the clinical variability in disease progression.

Several prognostic predictors exist for determining the course of ALS. Presentation with bulbar or pulmonary dysfunction, a short interval from symptom onset to diagnosis, electrodiagnostic findings primarily involving lower motor neurons, and advanced age all potentially indicate a poor prognosis. Women present with bulbar symptoms more often than men do. Bulbar palsy appears to progress more rapidly in women; this indicates a poor prognosis. Young males with ALS have the best prognosis and may have a longer life expectancy.

Overall, the median 50% survival rate is 2.5 years after diagnosis. In patients who present with bulbar symptoms, the 50% survival rate drops to 1 year. Survival rates vary,

depending on the patient's decision to use a feeding tube and assisted ventilation. Nonetheless, by 5 years after diagnosis, the overall survival rate is only 28%.

B.3. PARENT'S GUIDE TO LIVE WITH CHILD'S NEUROMUSCULAR DISORDER

3.1. Introduction

If you have always considered yourself a strong, collected person who is up for any challenge, or guilt and stress, then it is likely that your child's diagnosis with a NMD has drastically changed your perspective. Most parents who have gone through the same ordeal have found that there is almost nothing that can prepare you for the diagnosis. Everything that you thought you knew about parenting and every idea you had about raising a child is proven wrong in one painful instant.

Even if these are rare diseases, parents must realise that there are a lot of other families affected, in the community and internationally: One in 3500 new-born boys has a DMD disease. That means some hundreds of DMD boys in each country, maybe a dozen in your county, and other hundreds of NMD affected.

It is proven that finding others in the same condition as yours, to contact the organizations of parents, to speak with experienced people in the same situation, is very helpful in finding a way to leave and deal with this painful situation.

An important part of the coping process involves coming to terms with the facts about NMDs. By remaining ignorant about your child's disorder, you are allowing yourself to harbour some false assumptions about what it implies about you or your child. Some people actually continue to feel guilty their whole lives, believing that somehow they were at fault for their child's condition and that they could have done something to prevent it. If you are informed about the condition, you can clear these false assumptions from your mind, freeing yourself from a considerable load of guilt and stress.

This chapter is addressed to parents and/or carers of a child diagnosed with a neuromuscular disorder (NMD). The aim is to offer support and information to families at this difficult time, and includes the queries most often asked by parents.

3.2. Psychosocial issues for parents

"Living with NMDs means enjoying today"

Often, unfortunately, many affected families and persons starts to define their life as a "disabled life". But, remember that having a disease not means that your life is a disease. A NMDs condition, or a DMD condition, is **just a part** of your life. The other parts needs to continue to have their role and to design your personality, for the seek of your beloved.

If you became well informed and you accept the things that it is not in our power to change, if you live any moment with your child as a quality moment, then you accomplished your duty.

Important issues for parents

Living with a neuromuscular disorder means continuous change and personal challenge. Accepting the fact that you have a serious, disabling illness that is not yet curable does not mean giving up and doing nothing.

Rather, it means continuing to do as much as you can and channeling your time and energy into maintaining the best quality of life and independence. The physical effects of neuromuscular disorders vary greatly from one person to another, as does the rate of progression. So there is little to be gained from worrying about the future, over which none of us has any control, and much to be gained from enjoying today.

You may find it helps to talk through any feelings or worries with someone outside the immediate family. A close friend, an understanding relative, a social worker or your doctor could all be useful support. You may also like to talk to people at your local Muscular Dystrophy/other NMDs organisations from your country by contacting your local office (*see at the end of the book, Useful contacts*).

How to deal with the diagnosis

For many families, the diagnosis of a neuromuscular condition comes as a complete shock. The feeling that you may be responsible for your child's condition can be a common feeling. If you were aware of your carrier status you will have made choices in line with your beliefs. This is the right thing to do, be true to yourself.

If you were unaware but genetic testing shows that you have passed on the condition, it is important to remember that you had no knowledge of this. We are not routinely screened for these conditions. We all carry some faulty genes but, mostly, we're lucky enough never to find out about them.

Parents may have suspected that their child had a problem but they rarely expect this diagnosis and seldom know about muscular dystrophy or related neuromuscular disorders. For others, there may be a known family history.

Different people respond in different ways to difficult news. There is no right or wrong way to respond, just your own way. How the information was delivered is important. Sensitivity on the part of the medical team is vital. Families should feel that the team is supportive, approachable and caring.

Parents with a newly diagnosed child often feel the need to do something with the information they have received but there is no need to rush. Respect your feelings and take your time.

Depending upon the age of your child at diagnosis, there are a number of things you can do to assist him/her and there is more about this later in the booklet. Equipping yourself with information and identifying local sources of support are important. It is also important to have a follow up plan from the clinic where the diagnosis was made.

What to say to your child and when

What you say will, of course, depend upon your child's age and level of understanding. What is important is to try and ensure that what you say is truthful and makes sense to your child.

Unless they are very young, most children quickly realise there is a problem. They know they are attending hospital and may see their parents upset. It is important, therefore, to explain.

Some parents say things like "the doctors have found out that some of your muscles are rather weak. They can't make them better at present but lots of people are working very hard to see what they can do to help". This is a good starting point and allows you to "drip feed" information over time.

Avoid denying there is a problem, or promising that it can be made better.

If your child asks if he/she will get weaker then be honest, but also stress that things can be done to help him/her continue doing a whole range of activities.

Your child needs to trust you and being honest will, in the longer term, help to maintain a good relationship. Remember, children are concerned with today. They are unlikely to take a long term view.

Some parents may find it very difficult to talk to their child while they are trying to come to terms with the diagnosis themselves.

What to say to other adults in the family

Unless there is a good reason not to, you should tell your relatives the truth. You will need their support and understanding in the coming years.

As these conditions are usually genetic, other family members may like to be referred to their local clinical genetics department for advice. They should discuss this with their GP.

Be aware that other people may be frightened or upset by news of the condition and may not react in the way you would expect.

You can talk about these concerns, in confidence with the team caring for your child or the relevant genetic service. They are used to dealing with such situations and would never pass on information about you or your child to other family members without your approval.

What to say to your friends and acquaintances

What you say will very much depend upon how close people are to you.

Agree together on the people you will share information with and ensure that these friends know it is given in confidence. It is not their information to share.

You may wish to give yourself time before sharing information outside your own close circle. Good friends are important but it can be difficult coping with other people's distress as well as your own.

How to cope with the way you are feeling

There is no right or wrong way to feel. You will probably feel different at different times. One minute (or day) you may feel able to cope but then feel much more fragile the next. Some parents have said they feel as if they are on a giant roller coaster but that the good days gradually start to outnumber the bad. It is never easy coping with the unfamiliar. Most parents have a vision for their child and it is very challenging when this vision is changed by something beyond their control.

Be kind to yourself. Understand that you will feel exhausted – grief is exhausting.

Prioritise what needs to be done and do ask for help. Try to have a little 'me' time each day. Some people find that talking to a counsellor can help. Don't be afraid to ask your GP to arrange this if you think it would be useful. Asking for help is a sign of strength and we all need extra support sometimes.

How to cope with your partner's feelings

No two people are alike and your partner may cope with the situation differently to you. It is important to respect these differences and accept that this is normal. It is hard to cope alone though, and it is often the case that one partner wants to talk while the other doesn't. Try to negotiate some agreed 'talking time' so that each partner's needs are at least partly met.

If one partner is out at work, the other may take on more of the responsibilities relating to the home and children, including attending clinics. Feeding back information from clinic appointments can be difficult. Understand that one partner may not have asked the same questions as the other. This difficulty can be partly overcome by compiling a list of questions in advance but it really helps if both partners can attend appointments together. Remember that people's level of acceptance about a situation varies. A trusted friend can be invaluable in offering support and professionals can also have a supportive role to play.

It helps to meet others

Many people do find it helpful to meet with other families who have a child affected by the same or a similar condition, but usually not straightaway. Perhaps an NMDs Care Advisor or staff at the clinic your child attends may be able to put you in touch with a family that has a child of a similar age to yours. You may wish to contact them by email initially. This allows you to control the amount and timing of the contact (and you do not have to disclose personal details to a stranger until you have established a relationship).

The majority of families who are in touch with an NMD Care Advisor do meet other families either at clinic, physiotherapy sessions or at NMDs NGOs events. Other families can be a unique source of information because, unlike the professionals involved, they are experiencing (or have experienced) some of the same emotions as you and have faced similar practical challenges. Details of condition specific support groups can be found *at the end of the book, Useful contacts*.

3.3. The diagnosis implications in child's development and behavior

Physical changes

Any changes in your child are likely to be subtle rather than sudden or dramatic.

In very young children you may in fact initially see positive progress. The progression will vary depending upon the exact condition. However, if your child is walking, common changes are tiring more quickly when walking longer distances, struggling more with stairs or falling more frequently. A child may struggle more at the end of the day, particularly if they have been busy with activities such as swimming, for example.

For some children, weakening of the arms or hands may occur. Writing for long periods or taking clothing over the head may become more difficult.

If your child is not able to walk at all, changes may take place in their posture or joint position due to weakness of some muscle groups.

It is good to gently encourage your child to be as active as they can but try not to deny that there is a difficulty. Your child needs to know that you understand that some activities are not easy.

Remember they are the same child they were before the diagnosis.

How the child will cope the diagnosis

You may be surprised at how well young children cope, however, as the condition progresses and changes occur, they will have to adapt. Coping with change is never easy and children may express their anger or frustration by displaying challenging behaviour.

Have clear guidelines about what is acceptable behaviour and what is not. It may be appropriate to give your child more information about their condition to help them make sense of the changes taking place. Try to involve your child in decision making and give them the space to develop friendships.

When you talk to your child, be sure to also listen, otherwise you could assume that he/she shares the same anxieties as you. They are more likely to be concerned with today, rather than tomorrow (or next year). Avoid being “over-protective”; he/she needs some adult-free time!

If your child is being teased or bullied, seek advice from school staff and work with them. With your child's permission consider informing classmates of the situation. This is often the best way to gain support and respect. Some children may benefit from talking to a counsellor. Art or music therapy can also be helpful and fun. Be aware that relatives and

friends may be over-indulgent with your child and “spoil” them. This can create tensions within the family and between siblings so give guidance on your wishes in this area.

Incontinence

This is very unlikely that your child become incontinent. Sensation usually remains normal and children will be aware of when they need to use the toilet. Of course, accidents can happen if a child delays going to the toilet and is then a little slow to get there. If your child does have difficulties, make sure you inform their consultant.

Constipation can be troublesome in some children, particularly if they are not very physically active. It can usually be managed by adjustments to the diet.

Seek advice from your child’s consultant.

Children with myotonic dystrophy may be slow to gain bladder and bowel control and some may always have problems with soiling.

Pain

Most neuromuscular conditions themselves do not cause pain but some children may be troubled by muscle cramps or joint pains. Advice and regular monitoring by a physiotherapist will be beneficial for most children. They are likely to provide a programme of stretches and exercises to try to maintain a good range of movements in the joints which will reduce discomfort.

Puberty and sexual issues

Children with neuromuscular conditions usually develop normally and experience puberty in the same way as others their age. As they get older, they may require an increasing amount of physical care and extra thought needs to be given to ways of maintaining privacy and dignity.

Your child will need opportunities to learn about sexual issues and form relationships with others. Sex education should be offered and opportunities to discuss relationship issues provided. Being physically dependent on others should not prevent your child increasing their independence in thought and actions. They will experience sexual feelings and may wish to be involved in sexual activity.

Eyesight, hearing, speech, learning difficulties

Most neuromuscular conditions do not cause difficulties with eyesight or hearing, however, some cause weakness of the facial muscles, which may affect speech and chewing ability. Difficulties with swallowing can occur in some conditions but a lot can be done to help. You can ask your specialist for a referral to a speech and language therapist who will be able to give advice.

Some children with neuromuscular conditions have learning difficulties but most do not. If learning difficulties are present, they will not be progressive and with the right input, good educational progress can be made. Many children will need extra support in school because of their physical difficulties. Ensure that your child is properly assessed by an educational psychologist.

School issues

Some children are already at school when they are diagnosed, others may not even be nursery school age.

A diagnosis of a neuromuscular condition does not mean that your child will have to attend a special school. Whether they do or not will depend on a variety of factors, including parental preference, the degree of any learning difficulties and the inclusiveness of a school.

The majority of children are able to attend a local primary school along with their friends. When selecting a school for your child it is important to explain to the Head Teacher that your child has a neuromuscular condition. This information enables the teaching staff to work with you, and plan appropriately for your child.

The clinic staff or therapists who work with your child might also be willing to talk to school staff about your child's condition and how it will affect them during their time at the school. This may well be the case for nursery schools too.

Think twice about sending your child to a school that sees only problems – the good will and support of teaching staff are vital. *Do raise any concerns you have about access issues.* The school you choose needs to be right for your child throughout their time there. A school with lots of steps, therefore, may not be a wise choice.

Most parents of young children want their child to be treated 'normally' and the majority of schools try to respect these wishes, however, allowances will sometimes have to be made to ensure your child's wellbeing. Agree with teachers what these will be and review them on a regular basis.

Other children in the class may ask about your child's special needs. Discuss with teachers, and your child, what explanation should be given. You may want someone to explain to the class that your child has a medical condition that causes muscles to weaken and makes certain activities difficult or impossible. Let the class know how they can be supportive, for example, by holding doors open and not pushing against one another. Only do this with your child's consent. A few children with neuromuscular disorders may prefer a special school environment particularly if they have a significant learning difficulty. Classes tend to be smaller and physiotherapy and other therapy services will probably be available on site. Some parents find a special school environment more supportive.

3.4. Caring for your child

About relation with paediatric and specialists team

Neuromuscular conditions are rare. Most GPs do not see more than one or two patients with these condition in their entire career. Professionals who do have experience of these conditions usually work at a specialist clinic. As they are experts in this field, you can feel reassured that the right issues will be discussed at the right times and you will be kept up to date with any developments.

Specialist clinics also have established links with other services that may be of help to your child.

The relationship between a family affected by a neuromuscular condition and the specialist team that supports them is an important one. A strong relationship based on good communication helps to create a supportive environment and means that if there's ever a difficulty, you and your child will be well known to the team. The relationship is also a partnership so feel free to question why an appointment is necessary, or ask for less frequent appointments if you feel this is appropriate. Different families appreciate different levels of support and the team will be keen to get it right for you. Let them know your preferences.

Unless your specialist centre is very near to you and has a community remit, you will also require support from local paediatricians. They can help you access local services such as physiotherapy. Local paediatricians will play a role in your child's care should they become unwell or be admitted to a local hospital. They will work with the specialist team, GP and school health services to champion your child's needs. Try, if possible, to space out the visits between the specialist centre and your local centre.

Many neuromuscular conditions cause problems with breathing, with the heart, with joints or with the spine. Your child may be referred to other doctors specialising in these areas. In some cases, input from other specialists may also be required.

Physical activity and physiotherapy

Keep your child as active as possible but try to make the activities fun. *There is no need for excessive regimes; normal play is the order of the day.* Allow your child to join in with games. They will judge for themselves if an activity is too challenging.

If appropriate, encourage walking but recognise that your child may tire more quickly than their friends, and make allowances for this. Activities like walking up hills and/or climbing stairs may be particularly difficult. If your child can manage them, swimming, cycling and horse riding are excellent activities. Liaise with your child's school about playground safety and the amount of activity they can manage, and review this regularly.

The team at your child's muscle clinic will usually make a referral to the local physiotherapy service. If this does not happen, inform the muscle clinic staff or ask your GP for help.

Most children with neuromuscular conditions benefit from regular physiotherapy reviews. A programme of regular exercises and stretching is likely to be suggested. Try to make these fun and part of the daily routine.

The night splints are worn at night. When a joint cannot move through its full range, because of tightened muscles, this is known as a contracture.

Night splints help to delay contractures because they hold the joint in a good position during the night. Splints are made from a variety of lightweight materials. A child should, preferably, wear night splints throughout the night but some children are unwilling to comply with this. It may be necessary to find a compromise, for example wearing the splints on weeknights only, or for just half the night. If it becomes very difficult then try persuading your child to wear them in the evenings whilst watching television. Night splints can be uncomfortable in hot weather and it may help if your child wears a cotton layer underneath them. It can also be difficult to turn over in bed when wearing splints. If night splints are uncomfortable or your child grows out of them, contact your physiotherapist or orthotist.

Special diet

There is no evidence to show that a child with a neuromuscular condition requires a special diet. Some children do experience difficulty with feeding and gaining weight. If this is the case your child is likely to be referred to a speech and language therapist and/or dietician. If there are no feeding difficulties, aim to establish a healthy eating pattern which maintains weight within a normal range. Avoid giving in to requests for fatty or sugary foods, as excess weight will make moving harder for a child with weak muscles. It will also make any moving and handling assistance needed more risky for you. Suggest to relatives/friends that alternatives to 'sweet/chocolate' treats may be more appropriate, for example, comics or games. If your child becomes less physically active, they will require fewer calories.

Alternative therapies

Sadly, *there is no evidence of any alternative therapy proving helpful.* Some non-invasive therapies, such as massage, may be pleasant and relaxing, but do seek guidance from your specialist before undertaking any. Avoid expensive 'treatments', invasive alternative therapies or trips abroad that promise cures. However, for any progressive disease is important to give body as many antioxidants as you can: more good water, fresh fruits and vegetable (depending on child preferences), helps a lot and provide a natural source of antioxidants.

Remember that research into neuromuscular conditions is well co-ordinated internationally and your specialist will be pleased to share information with you about any advances.

3.5. Issues about your family and child's future

We are all fearful of the unknown. *Your fears may ease as you acquire more knowledge and build relationships with the professionals involved in your child's care.* Research into many conditions is ongoing but the important thing is to support children in such a way that if, and when, treatment becomes available, they can maximise its benefits. You can stay up-to-date on research through your country's NMDs websites and/or by registering with the charities to receive research updates. Although there is currently no cure for these conditions, management techniques are getting better all the time. This has improved the outlook for many children and your consultant can advise you further.

But accessing services can be difficult. Many parents report changes in themselves as they use negotiation skills they never knew they had.

An adult's perspective is very different to a child's and most parents are surprised by their son or daughters' positive attitude. There will undoubtedly be difficult times but there will be lots of good times too.

Special equipments

Having a child with special needs can put pressure on a family's finances. Be clear about what the statutory authorities should provide. Some essential equipment for use around the house, such as banister rails and bath aids, manual and powered wheelchairs are provided (or must be) free of charge by social services. Ask in good time as the process of obtaining equipment can be a slow one. The NMDs NGOs or other charities can sometimes assist with equipment costs.

Parent's job implications

Many children with neuromuscular conditions live in families where their parents work. There are no definitive rights or wrongs in this situation. Much depends on the nature of your work, the flexibility of your employer and how much support you have from friends, family and/or paid carers. Every family is different. If you enjoy your job, it may be right for you to continue working.

However children with neuromuscular disorders often require more support from their parents than another child their age. They may need help with practical tasks and have a range of appointments to attend. These needs and appointments may increase as they get older. Appointments are generally during working hours and it can be difficult to take time out from a working day to attend them.

Ensure you have up-to-date advice on benefits or tax credits etc. Don't assume that you are not entitled to help because you are working or have income/savings at a particular level. Some benefits are not income related. A parent who gives up work to care for a disabled child can be entitled to financial help.

Housing needs

Many families worry that they will have to move house. Seek expert advice and don't rush into any decisions. Many children with a neuromuscular condition will need their own bedroom and a suitably equipped bathroom. You will also need to consider how they will get in and out of the property and access communal rooms if they are or become wheelchair dependent.

Housing issues can take a long time to sort out. If major alterations are likely to be needed, council and housing association tenants should advise landlords at an early stage of their child's diagnosis. Tenants of private landlords should seek advice from an occupational therapist and the housing department, as it can be difficult to make adaptations to privately rented properties.

An occupational therapist advises families and assesses current and future housing needs. You can generally refer yourself to the occupational therapy department (usually based at the local social services).

B.4. USEFUL CONTACTS

UNIVERSITATEA DIN CRAIOVA, Romania

Webpage: <http://www.ucv.ro/>
http://cis01.central.ucv.ro/educatie_fizica-kineto/

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FONDAZIONE OSPEDALI RIUNITI ANCONA ONLUS, Italy

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Elisa Marconi, email: elisa.marconi25@gmail.com

ACTION DUCHENNE LIMITED, United Kingdom

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UNIVERSITY EDUCATIONAL CIRCLE, Latvia

Webpage: <http://educationgroup.ucoz.lv/>

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NMD-PRO Project webpage:

<http://nmd-pro.ro/>

APPENDIX

STRETCHES, CORRECT POSTURE AND SPLINTS

It is very common in muscular dystrophy for muscles and tendons to tighten. Some muscles will be affected earlier than others. The first muscle to tighten is usually the calf muscle/achilles tendon at the ankle, but the muscles around the hips, knees, elbows and fingers can also be affected. Contractures can make some movements and activities more difficult. Regular daily stretches help maintain muscle length and keep joints mobile. There are three different types of stretches: passive, active assisted and self-stretches.

PASSIVE STRETCHES

Passive stretches are the cornerstone of physiotherapy management and an essential aspect of any programme, at all stages of the condition. It is never too soon to introduce passive stretching. As the name suggests, the child does not actively take part in the stretching process. Passive stretches are done therapist. Slow and firm passive stretching will not harm the joint or muscle and can be done every day. Tight and/or shortened muscle tissue is stretched by moving the joint as far as possible and maintaining the position for at least ten seconds (the physiotherapist may recommend longer, depending on child's needs). Done properly and effectively, passive stretching is not painful. Some children put up a mild protest at passive stretching but this is usually overcome once their confidence has been gained and a routine established.

It may help to do the stretching after a warm bath or after massaging the muscles to be stretched.

Position the child so that he or she is well supported and comfortable, and the joints not being moved are stabilised. The child must relax completely and not make any active movement or resist the stretch. If the stretching is done too quickly, the child is more likely to resist and become frightened. Start the stretch gently and gradually increase to a maximum intensity, without pain. Overstretching should be avoided.

MANUAL ACHILLES TENDON STRETCH

Position

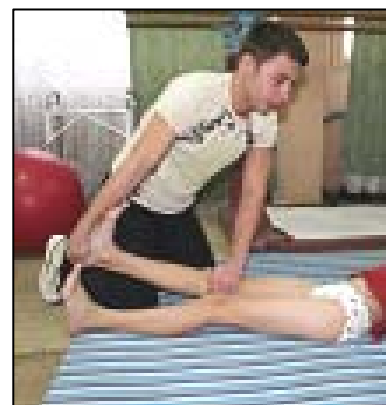
- Child lying on back
- Cup heel in hand
- Rest sole of foot on forearm
- Stabilise above the knee with the other hand

Stretch

- Pull down firmly on the heel while pushing the ball of the foot up. Keep knee straight
- Stretch is felt in calf

Special instructions

If resistance to stretch is felt, bend the knee, stretch the ankle then straighten the knee while maintaining the ankle stretch. Place support under the knee to prevent hyperextension.



MANUAL HAMSTRING STRETCH

Position

- Child lies on back
- Place ankle on shoulder (as in photograph)
- Stabilise the opposite leg with other hand
- Keep knee of moving leg straight with hand

Stretch

- Rock forward using this movement to perform the hamstring stretch
- Stretch is felt at back of upper thigh



HIP FLEXOR STRETCH (PLUS ILIOTIBIAL TRACT)

Position

- Child lies flat on tummy
- Cup bent knee in hand
- Ankle rests on elbow or upper arm
- Place other hand on bottom

Stretch

- Pull knee up and **towards** the other leg while applying downward pressure on the bottom
- Stretch is felt in groin and outside of hip

Repeat on other side



ILIOTIBIAL TRACT (MANUAL STRETCH IN PRONE)

Position

- Child lies on tummy
- Grasp leg to be stretched at knee
- Stabilise and keep pelvis and trunk flat with knee and hand

Stretch

- Lift leg up
- Pull leg across towards other leg
- Apply pressure on buttocks to keep pelvis flat
- Stretch is felt down outer thigh



ILIOTIBIAL TRACT (MANUAL STRETCH IN SIDE LYING)

Position

- Child lies on side with lower leg bent
- Leg to be stretched uppermost with knee straight
- Stabilise pelvis with hand and knee

Stretch

- Take leg backwards as far as possible
- Apply firm downward pressure at the knee
- Stretch is felt down outer thigh



HIP ADDUCTOR STRETCH IN SIDE LYING

Position

- Child lies on side with underneath leg bent
- Hold as in photograph
- Lower hand cups knee
- Other hand applies pressure on uppermost buttock
- Stabilise pelvis with knee.

Stretch

- Move top leg upwards until stretch is felt.



HIP FLEXORS ON BACK

Position

- Child lies on back
- Stabilise the lumbar spine by holding non-moving leg bent up on chest

Stretch

- Push down on leg to be stretched while holding other knee in bent position (as in photograph)
- Stretch is felt in groin



ELBOW STRETCH

Position

- Child lies on back or sits on chair
- With palm facing upwards
- One hand supports shoulder joint or upper arm
- Hold above wrist with other hand



FOREARM STRETCH (PRONATORS)

Position

- Hold child's hand as in photograph
- Stabilise the wrist
- Stabilise at the elbow

Stretch

- Slowly turn hand to 'palm up' position until stretch is felt



LONG FINGER FLEXORS

Position

- With elbow as straight as possible
- Support the child's palm, maintaining straight fingers
- Keep thumb out to the side
- Support the wrist

Stretch

- Slowly bend the wrist and hand back until a stretch is felt in the forearm



SELF STRETCHES

Self-stretches, as the name suggests, are stretches that the child is taught to do himself. These are most effective in children who are still walking and are particularly useful for the ankles, knees and hips.

PASSIVE SELF-STRETCH FOR TENDO ACHILLES ON SPALIER

Position

- Child stands on the first bar of the spalier
- Feet point straight ahead (or slightly pigeon toed)

Stretch

- Child positions heels as far back on board as possible
- Keep knees straight
- Keep heels down
- Stretch is felt at back of both calves



PASSIVE SITTING HAMSTRING STRETCH POSITION

Position

- As in photograph
- Knee should be as straight as possible and leg slightly out to the side
- Lower spine straight
- Sit with hips well back against the wall

Stretch

- Stretch is increased by leaning forwards
- Stretch is felt at back of straight thigh



PASSIVE SELF-STRETCH FOR HAMSTRINGS

Position

- Child lies on back in doorway or beside post
- Place leg to be stretched on the wall with knee slightly bent and bottom close to the wall
- Keep other leg straight

Stretch

- Straighten the knee until stretch is felt in back of thigh



Active assisted stretches

Active assisted stretches are done by the parents with the child assisting the movement. When a joint becomes contracted, the tight tissue prevents the opposite muscle group from working properly.

Active assisted stretches can stretch the tightened muscle and work the opposing muscle group at the same time. Active assisted stretches are particularly useful for the ankle. While you stretch the Achilles tendon, for example, your child pulls up his or her toes. The harder you work together, the more effective the stretch will be. This form of stretching helps the time pass more quickly and makes the stretches less boring for your child.

ACTIVE CALF STRETCHES STANDING POSITION (GASTROCNEMIUS)

Position

- Stand facing wall
- Keep back leg straight
- Heel on floor
- Knee straight
- Toes point to wall

Stretch

- Lean towards wall until stretch is felt in calf of back leg
- Keep bottom in



ACTIVE CALF STRETCHES STANDING POSITION (SOLEUS)

Position

- Stand facing wall with both knees bent and foot to be stretched behind

Stretch

- Lean into the wall, squat down slowly until stretch is felt in lower calf of back leg



POSTURE

Muscle weakness in key areas such as the spine and hips can affect the posture of a child with Duchenne muscular dystrophy. Weakness of the spine muscles can cause scoliosis and weakened hip extensor muscles cause lordosis. The child may adopt unusual postures – in sitting, standing and lying – to compensate for muscle weakness, limited mobility and contractures. It is important to correct these postures because, if left, they can cause further problems, particularly in the spine. Good seating at all times helps to maintain good posture.

Sitting

The feet should be at a 90° angle to the legs when the child is sitting down. The seat of the chair should be firm and, ideally, not too wide. The back of the chair also needs to be firm and either upright or slightly slanting backwards (10°). The seat should be as deep as the thigh is long, so that the child is encouraged to use the back of the chair and not slump. The armrests need to be at the right height and not too far apart so that the elbows can be supported without causing hunched shoulders or leaning.

Positioning

The way a child moves and the positions adopted – to write, eat or rest, for example – are a direct response to losing muscle strength and having contractures. Sometimes muscle strength and/or the stiffness of a contracture may be different on each side of the body. When this happens, an asymmetry or imbalance occurs which can cause scoliosis. Passive stretching and night splints can delay the onset of contractures but it is important to know which positions to encourage and which to discourage, without nagging.

Prone Lying

The prone lying position is good for resting. It can also help prevent contractures developing in the hips and knees. Prone lying can be combined with activities such as reading or watching television. The child lies face down on a floor, couch or similar firm surface. Place a small pillow or wedge just *below* the hips (which should be level and the pelvis down) to encourage hip extension. The weight of the lower leg will straighten out the knees but it is important that the feet are free. Discourage asymmetrical positions as these reinforce development of contractures and scoliosis.

Standing

Standing helps bone density and posture as well as assisting in the management of contractures. It should be encouraged, during the day, for short periods (half an hour) or longer blocks of time (two or three hours if possible, but you need not be prescriptive). When an older child or young adult finds it difficult to stand unsupported, but callipers are unsuitable, it may be helpful to use a **standing frame**, **swivel walker** or **tilt table**. They reduce the muscular effort required to stand upright and provide total body support, enabling the hip flexor, knee flexor and calf muscles to be fully stretched. Using a standing frame every day can delay the onset of scoliosis as well as aiding digestion and circulation. Children who have callipers often use these for standing.

Night splints

These are designed to be worn at night and are usually only for the ankles. They help slow down contractures by keeping the joint in the best position for the child. Night splints are made from a variety of materials, including polypropylene. The splint starts at the toes and finishes just below the knee. They must be comfortable and fit properly, as poorly fitting splints are unlikely to be worn and may prejudice the child against all splints. Research has shown that using night splints in conjunction with passive stretching is the most effective way of delaying the development of contractures. Night splints are never, however, a substitute for passive stretching and should only be used in combination with stretching once there is an obvious feeling of tightness. Day splints are very rarely worn by walking children as they can adversely affect mobility and make it more difficult to walk, climb, rise from a chair.

Callipers (KAFOs)

Some children can carry on walking independently for up to two years or longer by using orthoses called **K**nee **A**nkle **F**oot **O**rthoses (KAFOs). The young person uses a wheelchair for long distances but walks short distances at home. Because children with Duchenne muscular dystrophy have muscle weakness in the arms, shoulders and trunk, they cannot use walking aids such as crutches. A KAFO is an 'ischial weight bearing knee ankle foot orthosis', which makes use of the lordosis with which the child has become accustomed. It extends from the toes to the hip and the child sits on, or is supported by, the lip at the top of the high piece. KAFOs are made of olypropylene and have a hinge which allows the knee to bend when sitting.

To fit the orthoses, the foot must be at a right angle to the leg. Orthoses do not need to be fitted before the child has either stopped walking independently or is falling more frequently. It must be done, however, before the child has been dependent on a wheelchair for more than two or three months, and is best done when the child has only just lost the ability to walk independently.

It is suitable for the child with enough strength in the hips and trunk to balance, the child who wants, and will accept, them and the family who can manage.

The advantages are:

- Independence in the home and classroom
- A delay in the development of scoliosis and contractures in the hips and knees
- Easier transfer between chair and car, etc.
- Easier toileting.



UNIVERSITY OF CRAIOVA, ROMANIA

http://cis01.central.ucv.ro/educatie_fizica-kineto/



ASOCIATIA PARENT PROJECT, ROMANIA

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