Developmental Disabilities through the Life Span: Aging with Cerebral Palsy
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My Journey....

Pediatric Rehabilitation Medicine
- Pediatric PM&R or Pediatric Rehabilitation Medicine (PRM) is the subspecialty that addresses prevention, diagnosis, treatment, and management of congenital and childhood-onset physical/neurological impairments and related or secondary medical, functional, psychosocial, cognitive, and vocational limitations with an understanding of the life course of disability.
Pediatric PM&R

- Rehabilitation: acutely acquired disabilities, inpatient and outpatient
- Habilitation: early onset, long-term outpatient
- Diagnostic groups differ from adults; inpt vs outpt
- Family centered
- Pros/Cons: Patient age and family
- Vocation: school
- Constantly changing targets: effects of growth and development
- Age-based needs
- Therapy services: Early Steps (0-3), center/clinic based, home care (rare), school
- Payor coverage issues for therapy, equipment, bracing; Medicaid rather than Medicare

CHILDHOOD DISABILITIES

- Developmental Delay
- Cerebral Palsy
- Spina bifida
- Genetic syndromes
- Muscular dystrophies / neuromuscular disorders
- Acquired brain and spinal cord injuries (traumatic, infection, tumor)
- Acquired neurological conditions: Guillain Barre, transverse myelitis, stroke
- Generalized deconditioning/critical illness myopathy
- Secondary effects of cancer/cancer treatment

PM&R Role at JDCH

- General physiatry office practice: hospital f/u, acquired and developmental disabilities diagnoses
- Muscular Dystrophy clinic (pulmonology)
- Wheelchair/Equipment clinic
- Spasticity clinic (neurosurgery)
- Inpatient consultation
- Inpatient rehab unit admissions
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**Other JDCH PM&R department services**

- “Early Development Clinic” (EDP)
  - NICU follow up/newborn/0-3 years
  - Physician eval, therapy developmental screening

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**Inpatient Physiatry**

- Inpatient consultation
  - Determination of next level of care for rehab needs – eval for inpatient rehab unit admission
  - Management/co-management of secondary complications such as spasticity, autonomic dysreflexia, contractures, bowel/bladder (quality, safety, LOS)
  - Pre-habilitation recommendations such as positioning, splinting (quality, safety)
  - Functional evaluations (quality, LOS, safety)
  - Therapy recommendations (inpatient) (quality, safety, continuity)
  - Assists w/discharge planning (LOS)
  - Equipment recommendations (safety, LOS)
  - Facilitate outpatient follow-up (continuity)
  - Follow up w/existing physiatry patient (continuity)

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**Pediatric Inpatient Rehabilitation**

JDCH west, 6-bed CARF accredited unit
Admitting service
Multidisciplinary, physiatry presence
Interdisciplinary team
Inpatient Pediatric Rehabilitation from Infant to Teen

Pediatric and Adolescent Specialized Therapists, Nursing & Physiatrist

A Special Place for Families for respite

Child Security System for safety of all children, with Parent Approved visiting Lists

Broward County Special Needs Classroom and Teacher to assure completion of grade level during long hospital stays

Team Conference and parent meeting designed for the needs of children and adolescents. Focusing on re-entry to home, school, and community.

Family Spaces throughout the hospital designed for families and patients to reconnect with computers, library, teen room, and play

Room Service Kitchen with kid friendly selections serving food on demand.

Menu selection by the patient and parents

Family Lunch and Brunch Weekly

Family Advocates who meet with parents, assist and mentor to families to the hospital environment.

Pediatric Social Work and Neuropsychology

Get Well Network interactive network on the in room TV

Child Life Specialist Department - Daily and Weekly Activities for Family and Youth - Providing Medical Play - Mentoring Socialization for home and community re-entry - Leading Peer Support and Interaction

Why refer to the physiatrist – Outpatient Peds

PM&R

Treat patients who have a wide range of problems including developmental disabilities, cerebral palsy, spina bifida, acquired brain injuries, spinal cord injuries, muscular dystrophies, nonsurgical orthopedic alignment/gait. Focus on treating the medical and rehabilitation concerns associated with the physical impairment as well as working to restore function to patients.

General evaluation and management, spasticity management (including medications, botulinum toxin injections and intrathecal baclofen pump management), orthotic/prosthetic prescription, durable medical equipment prescriptions, and therapy prescriptions (including specific modalities).

Collaboration with physician specialists, therapists, psychologists, and orthotists and recommend referrals

School and community resources
Childhood Onset Disabilities

Cerebral Palsy
- Most common childhood disability
- 3.1 / 1,000 children prevalence (CDC 2008)
- Occurs 1.2 to 2.5 per 1,000 live births
- 8,000 new cases each year in US
- 500,000 children under the age of 18 living in US (1999)
- About 764,000 children and adults in the US currently have cerebral palsy
- California: 50,000 children and adults with CP (2010)
- 85% have spasticity (high muscle tone)
- 52% decline in mortality since 1983
- Severe CP mortality 1983 mean age 11
  • 2010 mean age 17
- Normal life expectancy with mild-moderate deficits, 85% of moderate to severe deficits live to age 50

Down Syndrome
- Incidence between 1 in 1,000 to 1 in 1,100 live births worldwide
- Approximately 3,000 to 5,000 children born annually
- About 250,000 families in the USA are affected by Down Syndrome.

Spina bifida
- 3,000 pregnancies in the US
- Had been second most common disability in children
- Incidence declining due to folate fortification of foods in US and folic acid supplement guidelines
- Prevalence has also decreased due to early prenatal detection and pregnancy termination
- 70,000 individuals living in the US

Traumatic Brain Injury
- 10-20/ 100,000 population with moderate to severe TBI
- 275,000 total hospitalizations per year (ALL AGES)
- Incidence: Three age peaks (2 peaks under the age of 30)
- 18,000 hospitalizations ages 0-4 and 24,000 hospitalizations ages 5-14 (CDC, 2004)
- Most TBI found ages <30, but 2/3 will live another 30-40 years (NIH, 2000)

Spinal Cord Injury
- Estimated incidence 40/one million population (all ages, NSCID)
- 12,000 new cases per year in US (NSCID)
- Ages 0-15 3-5% of all SCI
- Estimated 230,000-300,000 people living in US with SCI (NSCID, 2008)
- 50%

Down Syndrome
- Hypotonia, variable degree
- Developmental delay, variable degree
- Dysphagia (more severe cases)
- Congenital heart disease 40-45%
- Hearing loss 40-80%
- Vision problems
- Increased incidence of intestinal disturbances
- FTT early infancy, later
- Gut abnormalities (often early), orthotics
- Risk of fracture, physical deformations
- Risk of hip pathology
- Risk of sphero-ocular instability, scoliosis, spine issues
- Sleep apnea
- Early intervention/education
- 80% reach age 50+ years
Spina bifida (Myelomeningocele)
- Abnormal spinal cord function
- Often associated with hydrocephalus or VP shunt
- Musculoskeletal issues: scoliosis, back pain, LE pain, LE deformity, contractures, hip pathology
- Mobility issues, bracing
- Skin: decubitus ulcers (insensate)
- Neurogenic bladder (possible surgeries such as ileostomy, Mitrofanoff procedure (appendix is used to create a conduit between the skin surface and the bladder)
- Neurogenic bowel (possible surgery such as Malone antegrade colonic enema (MACE))

Neuromuscular Diseases
- Muscular Dystrophies
  - Duchenne MD
  - Becker MD
  - Emery-Dreifuss MD
  - Limb-Girdle MD
  - Facioscapulohumeral MD (FSH)
  - Myotonic Dystrophy
  - Oculopharyngeal MD
  - Distal MD
  - Congenital MD
- Motor Neuron Diseases
  - ALS/Lou Gehrig's Disease
  - Spinal Muscular Atrophy (SMA)
  - Spinal Bulbar Muscular Atrophy
  - Adult Spinal Muscular Atrophy

Neuromuscular Diseases
- Diseases of the Neuromuscular Junction
  - Myasthenia Gravis
  - Congenital Myasthenia Gravis
  - Lambert-Eaton Syndrome
- Diseases of Peripheral Nerve
  - Charcot-Marie-Tooth Disease
  - Hereditary Motor Sensory Neuropathy
  - Dejerine-Sottas Disease
  - Friedreich's Ataxia
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**Neuromuscular Diseases**

#### Endocrine Myopathies
- Hypothyroid myopathy
- Hyperthyroid myopathy

#### Inflammatory Myopathies
- Dermatomyositis
- Polymyositis

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**Neuromuscular Diseases**

#### Other Myopathies
- Myotonia Congenita (Thomsen's or Becker's)
- Paramyotonia Congenita
- Central Core Disease
- Nemaline Myopathy
- Myotubular Myopathy
- Hypokalemic/Hyperkalemic Periodic Paralysis

#### Metabolic Disease of Muscle
- Phosphorylase Deficiency (McArdle's disease)
- Acid Malate Deficiency (Pompe's disease)
- Phosphofructokinase Deficiency
- Debrancher enzyme Deficiency (Fabry's disease)
- Carnitine Deficiency
- Mitochondrial Myopathy
- Lactate dehydrogenase Deficiency
- Phosphoglycerate kinase deficiency

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**General Principles**

- Muscle weakness/muscle wasting
- Loss of strength and mobility
- Contractures
- Respiratory problems
- Slowed gastric and intestinal motility
- Dysphagia
- Risk for skin breakdown
- Pain
Common reasons for hospitalization

Respiratory
1. Infections
2. Respiratory insufficiency
3. Tracheostomy
4. T&A

GI
1. G-tube
2. Fecal impaction/constipation
3. GER
4. FTT

Common reasons for hospitalization

Skin
1. Decubitus ulcer/ wound care

Orthopedic
1. Tendon/lengthening surgeries
2. Spine surgery/orthosis surgery
3. Hip osteotomy surgery

Other
1. Diagnostic muscle biopsy
2. Acute pain/ inflammation
3. Endocrine or metabolic management

Nursing things to think about

Positioning
Respiratory
GI
Immobility
Call light
Extra equipment
Changing condition (often)
Psychosocial issues
Aging with Brain Injury

80% now live past age 65 (previously 10%)

Long term issues:
- Underemployment
- Seizure disorder
- Behavior/psychiatric disorders including depression/anxiety
- Substance abuse
- Social integration issues, isolation
- Aging: falls/fractures, degenerative musculoskeletal problems

Cerebral Palsy

- What is CP?
- Forms
- Etiologies
- Treatments
- Patient needs/issues
- Expectations

"a nonprogressive disorder of motion and posture due to brain insult or injury occurring in the period of early brain growth (generally less than three years of age)"

- Lord
Definition of Cerebral Palsy

2006 Executive Committee report

- Cerebral palsy describes a group of permanent disorders of the development of movement and posture, causing activity limitation, that are attributed to non-progressive disturbances that occurred in the developing fetal or infant brain. The motor disorders of CP are often accompanied by disturbances of sensation, perception, cognition, communication, behaviour, by epilepsy, and by secondary musculoskeletal problems.

Cerebral Palsy

- Nonprogressive
- Immature brain
- Abnormal tone and reflexes
- Alters movement / posture
- Increasing premature survival, higher incidence in normal weight term, longer survival overall
- Wide spectrum of presentation
- Varied time frame of symptom recognition

Cerebral Palsy

- Not a single disorder
- Heterogeneous in origin
- Complex CNS pathology
- Variable presentation and prognosis
- Requires a multidisciplinary approach
Cerebral Palsy

- Neurological symptomatology
- Motor dysfunction
- +/- Cognitive Developmental Delay

Clinical Presentation of Motor Dysfunction

- Difficulties with isolated/selective motor control
- Motor coordination difficulties/motor performance issues
- Strength issues

Associated Disorders:

- Sensory, cognitive, communicative impairments
- Vision deficits, hearing deficits, seizures, secondary musculoskeletal problems

Associated Disorders

- Sensory impairments
  1. Proprioception
  2. Stereognosis
  3. Two point discrimination
- More common in hemi CP
- Can be seen in opposite side

- Visual impairments, prevalence 39-100%
  including visual field deficits, strabismus, ROP, cortical visual impairment, severe myopia
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**Associated Disorders**

- Hearing impairments
  - TORCH, ototoxic drugs, meningitis, kernicterus
- Cognitive impairments
  - Heterogeneous
  - 50%-70% have IQ<69
- Psychological impairments
  - Prevalence of emotional/behavioral problems 30%-80%, not well-defined.
  - Attention, immaturity, anger, impulsive, emotional lability, anxiety, low self-esteem

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**Associated Disorders**

- Epilepsy
  - Overall occurrence 15%-55%
  - More common in more severe cases and in hemi CP
- Oral motor impairments – swallow, drooling
- Speech disorders
- GI/Nutrition
  - Feeding problems in 50% of mod-severe CP
  - High incidence of GER, constipation
  - Some portion of CP population is over-fed/obese
  - Challenge to measure stature
  - Lack of ability to communicate hunger
  - Vit D / Calcium deficiencies

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**Associated Disorders**

- Bone and Mineral Density
  - Mod-severe non-ambulatory CP have increased risk for decreased BMD and increased risk of fracture with minimal trauma
  - By age 10, most nonambulatory CP have osteopenia (BMD z score < -2.0)
  - Femur
  - Risk factors: poor feeding, lower triceps skin fold, anticonvulsant use
- GU disorders
  - Incontinence: 54% of CP quad and 80% of CP hemo/diplegia are bladder continent (cognition most common factor)
  - Other issues: frequency, urgency, hesitancy, urinary retention
- Respiratory disorders: ineffective cough, aspiration risks, impaired control of inspiratory muscles, seizures, increased airway secretions, BPD
Clinical Presentation of Motor Dysfunction

Tone abnormalities
- Hypotonicity, spasticity, dystonia
- Ataxia, choreoathetosis and other movement disorders

Reflex abnormalities
- Hyperreflexia
- Primitive reflex activity

Delays in developmental motor skill acquisition

Abnormal Muscle Tone in Cerebral Palsy and other disabilities
- Hypertonia
  1. Spasticity
  2. Dystonia
- Hypotonia
- Rigidity
- Abnormal patterns of movement
- Movement disorders
  1. Ataxia
  2. Choreoathetosis

Anatomic Patterns of Cerebral Palsy
- Hemiplegia/hemiparesis (30%)
- Quadriplegia/quadriparesis (tetraplegia, double hemiplegia) (30%)
- Diplegia (30%)
- Triplegia
- Monoplegia/monoparesis
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**Patterns**

- Degree of severity of the motor impairment varies greatly, even within a body pattern
- Degree of severity of associated conditions varies greatly
- Proportion of CP that is most severe is increasing: nearly 33% of all children with CP have both severe motor and cognitive impairments

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**Etiology**

- **Prenatal**
  - HIE, brain structure, stroke, genetic, infection, SGA
- **Perinatal**
  - trauma, birth asphyxia, prematurity complications
- **Postnatal**
  - trauma, infection, prematurity complications, stroke, kernicterus

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**Risk Factors**

- Prematurity
- Low or very low birth weight
- SGA
- Twinning
- Abnormal neuro exam in first days of life
- Low Apgar scores (<3 at 5 min)
- Seizures in first 48 hours
- Maternal infection
- Maternal thrombolytic disease
- coagulopathy
- Rh incomp/kernicterus
- Traumatic labor/delivery
- Birth asphyxia
- Mechanical ventilation
- ECMO
- Dysmorphism/ organ anomalies
Infant groups

- Preterm infants and full-term infants who are systemically ill in newborn period. PVL – spastic diplegia
- Full-term infants with neurologic dysfunction in the perinatal period – spastic quadriplegia
- Normal birth weight infants with no history of pre- or perinatal injury – majority of CP cases in normal BWT infants occur in those with Apgar scores 7-10 at 1 min.

Rates of CP

- Prematurity
  - 40-150 per 1,000 live births
  - 5/1,000 33-36 wks GA
  - 30/1,000 ≤28 wks GA
  - Could account for up to 50% of CP
- Term
  - 2/1,000 live births
  - Greatest number of existing CP cases in Australia 1981-1992 (prenatal or perinatal)
  - Birth asphyxia: <10% (can be confused with intrauterine infection exposure or coag disorder)

Pathology

- >80% have abnormal neuroimaging
- PVL most common (56%): can be diplegia or quadriplegia or hemiplegia
- Deep gray matter lesions basal ganglia and thalamic: dystonic, movement disorders
- Focal cortical infarcts (hemiparetic, 30%)
- Brain malformations (10%): term infants, hemiparetic
- Diffuse injury: encephalomalacia, cysts, thinning, grey and white matter loss, microcephaly (quadriparetic)
Genetic Causes of Cerebral Palsy

- Only 10 to 15% of CP cases can be attributed to intrapartum problems (Blair and Stanley, 1988).
- The other major risk factors: prematurity, small size for gestational age, and multiple pregnancy (Stanley, 1994).
- Approximately 2% of all CP cases in Swedish and English children are due to a genetic cause

Causes of Functional Impairment in Cerebral Palsy

Primary
1. Hypertonia
2. Absent selective motor control
3. Weakness
4. Disordered balance

Secondary
1) Progressive orthopedic deformities
   - scoliosis
   - joint subluxation/dislocation
   - foot deformities
   - soft tissue or muscle/tendon contracture
2) Pain

Impact of Pain on QOL

- Increased days of school missed
- Limits participation in daily and family activities
- Parents express more worry and anxiety about their child’s health and well being

Fauconnier et al. BMJ; 33:b1458
Incidence of Pain in children with CP

- Knees, ankles, feet, and lower back
- More frequently reported in girls
- Pain is related to severity of motor impairment
- Pain is reported in 48%-64% of individuals with CP and was the number one complaint in adult patient surveys
- Pain interfered with “normal” activity in 33%

Doralp and Bartlett Ped Phys Ther 2010;22: 26-33
Tervo et al Arch Phys Med Rehabil 2006, 87: 928-34
Houlihan et al Devel med Child Neur 2004; 305-310

Musculoskeletal Disorders

- Foot/ankle: contracture, midfoot pronation, hindfoot deformity, bunions
- Knee: contractures, genu valgus, patella alta
- Hip: hip dysplasia leading to subluxation/dislocation
  - More frequent in more severe cases (higher relation with GMFCS)
  - Gait, leglen, lifting posture issues
  - Future pain and osteoarthritis
- Spine: scoliosis, kyphosis, lordosis
  - Overall incidence of 40%
  - Risk factors: scoliosis, kyphosis, lordosis
- Upper extremity: shoulder, wrist, hand, fingers
  - Risk factors: shoulder pain, pain, upper body pain, pelvic obliquity

Gait

- Multitude of gait impairments
- Etiologies include weakness, hypertonia, muscle imbalance across a joint, poor selective motor control (isolated motor control), range of motion limitations, bony rotational abnormalities, limb length inequalities
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Treatments

- Medications (oral, intrathecal baclofen pump) for tone, spasticity, other
- Evaluation of developmental milestones, functional skills, gait
- Braces
- Splints
- DME: wheelchairs, standers, assistive devices
- Therapy prescription including modalities and location/type
- Injections: botulinum toxin, phenol for spasticity
- Nutritional/dysphagia management

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Nutrition / dysphagia

- Supplements
- Dysphagia evaluation (MBS? FEES?)
- Dysphagia treatment (VitalStim)
- Diet modifications
- Tube feedings

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Mainstays of Treatment

- Therapy (incl aquatics, hippotherapy)
- Splints and braces
- Equipment
- Address associated/concurrent medical problems
- Special Education
- +/- Orthopedic surgery
General Treatment Principles

- Need multidisciplinary approach
- Need to have short and long term goals; set expectations
- Functional goals beyond gross motor and walking: self-help, communication, social participation, academic
- Heterogeneous group of patients, little scientific evidence for treatment approaches, lack of controls

Therapy

Pediatric Therapy
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**Therapies**

- Stretching and strengthening
- Functional task and gait training
- Neuromuscular electrical stimulation (NMES)
- Functional Electrical stimulation (FES)
- Constraint –induced therapy (CIT)
- Partial Body Weight Support Treadmill
- Augmentative communication

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**Therapy Prescription**

- Therapy "dose"
- Therapy outcome expectations, resource utilization and justification
- Therapy oversight and timing of interventions
- Serial casting? Sensory Integration (SI)?
- Aquatics? Hippotherapy?
- E-stim, FES, VitalStim?
- Constraint Induced Therapy (CIT)?
- Robotics, short intensives, balance training?

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**Communication**
Braces (Orthotics) and Splints

Tools for Improved Alignment

- Splinting
  - Static
  - Dynamic
- Bracing/orthotics
- Casting


Seating Systems

- May decrease abnormal tone, enhance alertness, function, postural alignment, and comfort
- Interaction with environment
- Maximize upper extremity, respiratory, and swallowing function
- Minimize contracture, provide optimal environment for skin integrity
Importance of Standing

Use of Assistive Technology
- Manual mobility
- Power mobility
- Switch use
- Augmentative communication
- Computer access
- Environmental controls

Treating Hypertonia
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Traditional Step-Ladder Approach of Management of Spasticity

- ITB Therapy / SDR
- Orthopedic surgery
- Injection therapies (Phenol, botulinum toxins)
- Oral medications
- Rehabilitation therapy/bracing
- Remove noxious stimuli

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Spasticity Management
Spectrum of Care

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Orthopedic Surgery

- Soft tissue
  - Lengthenings/releases
  - Tendon transfers
- Bony procedures
  - Osteotomies
  - Fusions
  - Spine
Hypertonia Management Treatment Options

General
- Oral medications
- Intrathecal Baclofen Therapy
- Selective Dorsal Rhizotomy

Reversible
- Focal
- Intrathecal Baclofen Therapy

Permanent
- Orthopaedic surgery

Focal


Current Treatments
Tone – Spasticity vs. Dystonia
Movement disorders
Oral medications
1. Valium
2. Baclofen/Lioresal
3. Dantrolene Sodium/Dantrium
4. Tizanidine/ZanafLEX
5. Trihexyphenidyl / Artane
6. Klonopin
7. Sinemet
8. Other movement disorder drugs

Medications
- Spasticity /dystonia (oral, injections, intrathecal)
- Movement disorders
- Constipation
- Behavior
- Drooling
- Pain
- Acute brain injury recovery: autonomic storm, neurostimulation
- Sleep
**Injection Therapies**
- Reversible
- Localized/focal treatment
- Can be relatively expensive depending on drug
- Can be used across multiple groups impacting multiple joints
- May be helpful during growth spurts in children
- Can be used in conjunction with ITB Therapy/ SDR/oral meds/orthopedic surgery

**Orthopedic Surgery**
- Not reversible
- Focal treatment
  - Single
  - Multi-level
- Not treating spasticity directly
- Does treat symptoms/effects of spasticity
- Spasticity will recur unless treated medically after ortho surgery
Selective Dorsal Rhizotomy

- Surgical transection of dorsal lumbar rootlets
- Not reversible
- General treatment for lower extremity spasticity
- Does not work on dystonia
- Need for intensive post-op inpatient and outpatient rehab
- Unknown long term effects on spine/hips


Baclofen Pump

- Intrathecal Baclofen Therapy

1. Programmable Pump (SynchroMed)
   - Placed subcutaneously or subfascial in the lower abdomen
2. Catheter
   - Placed in the intrathecal space lumbar level, then advanced to desired level
3. Catheter then connected to pump
4. Pump and catheter surgically anchored
5. Programmer
   - Adjusts dosage by radiotelemetry

ITB Therapy – Overview

- Programmable Pump (SynchroMed)
- Placed subcutaneously or subfascial in the lower abdomen
- Catheter
- Placed in the intrathecal space lumbar level, then advanced to desired level
- Catheter then connected to pump
- Pump and catheter surgically anchored
- Programmer
- Adjusts dosage by radiotelemetry
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**ITB TherapySM**
- Allows for accurate administration to site of action
- Programmable—Non-invasive dose adjustments
- Subcutaneous refills into pump reservoir
- Gives appropriate amount of baclofen depending on specific needs of the individual

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**Re-assess Equipment And Therapy Needs**
- Seating system
- Standing equipment
- Assistive devices for gait
- Orthotics
- Bathroom equipment
- Assisted technology
- Augmentative communication
- Frequency/intensity/addition of therapy services

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**Aging with Cerebral Palsy**
- Musculoskeletal problems: joint pain, muscle pain, spinal stenosis, scoliosis, arthritis, overuse/mechanical stress
- Ongoing need for tone management
- Radiculopathies
- Reduction in ambulation with age
- Importance of conserving
- Constipation/decreased gastric motility/GERD
- Osteoporosis
- Dysphagia
- Restrictive lung disease
Pediatric Rehabilitation

“...goal in pediatric rehabilitation is not an end point as in the adult world. Rather, it is a process toward the continued development of ever-changing abilities and emotional, behavioral, and cognitive structures.”

- Distinguishing dimension in pediatric rehab: growth and development
- Dual goal: rehabilitation to prior levels and habilitation for the remaining development”

Jane Crowley and Kayla White-Waters
Pediatric Rehabilitation: Principles and Practice, 2010

OUTCOMES

QUESTIONS?

- Pediatric Rehabilitation: Principles and Practice- 4th ed. 2010
- Alexander and Matthews, editors
- Demos Medical Publishing