ACSM Registered Clinical Exercise Physiologist Workshop
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Henry Ford Hospital
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Neuromuscular Disorders

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Neuromuscular Outline

- General information
- Stroke
- Multiple Sclerosis
- Cerebral Palsy
- Parkinson’s Disease
- Post-polio
- Spinal Cord Injury ( & Spina Bifida)
- Resistance Training (General)
- Cardiovascular Exercise (General)
- Pain
- Resources
Cardiovascular Exercise Benefits
Tremendous Bang for the Buck

• Improved insulin sensitivity
• Reduction in cardiovascular morbidity and mortality
• Reduced blood pressure, stroke, type 2 diabetes
• Reduced cancer risk (some forms)
• Improved physical performance
• Decreased heart rate and systolic blood pressure at submaximal work rates
• Reduced fatigue
• Improved quality of life
• Improved sleep habits
Terminology in Exercise Physiology and Physical Activity

- **Physical activity** – all forms of bodily movement produced by contraction of skeletal muscle that substantially increases energy expenditure.
  - **Subcategories:**
    - Exercise
    - Leisure-time physical activity
    - Household
    - Occupational
Terminology

• **Physical Fitness**: A state characterized by:
  – an ability to perform daily activities with vigor
  – demonstration of traits and capacities that are associated with low risk of premature development of the hypokinetic diseases.

• **Six components**:
  – Cardiorespiratory endurance
  – Muscular strength and endurance
  – Flexibility
  – Body composition (BMI, bone mineral density)
  – Balance
  – Pulmonary function
Terminology

• **Met** – metabolic equivalent
  – Average resting metabolic rate for all persons regardless of body weight
  
  – 1 MET = 3.5 ml/kg/min. (resting level)
  – Any movement above resting levels requires a certain MET level.
Importance of Peak VO$_2$

Daily Physical Activities

• Traffic lights require a speed of 3 mph (80 m/min) to cross a street.
  – Gait speed of 80 m/min requires a VO$_2$ of approximately 12 ml.kg.$^{-1}$min$^{-1}$
  – Mean peak VO2 of UIC stroke cohort: 12 ml.kg.$^{-1}$min$^{-1}$
Fitness Testing for Persons with Disabilities

• Importance of aerobic exercise: completing activities of daily living, etc.
  – Testing: PWD often do not achieve a “true” VO2max – but rather, they reach a “peak” VO2.
  
  Difference is VO2max requires limitation of exercise from oxygen supply rather than fatigue, motivation, pain, symptom

  Measured in lab or field-based testing
  
  Nifty new ways – backpack, smaller metabolic carts.

  – In a non-clinical setting can utilize 6 minute walk test, SpeciFit Walk test, ergometer or other field-based test.
VO$_2$ for Common Household Chores

- Making beds, mopping, laundry = 10-12 ml.kg.$^{-1}$min.$^{-1}$

- Because individuals would have to perform these activities at maximal effort, they could become exhausted by activities that are often required to live independently.
Benefits of Exercise

- Increased cardiac and pulmonary function
- Improved ability to perform activities of daily living
- Protection against development of chronic diseases
- Decreased anxiety and depression
- Enhanced feeling of well-being
- Weight control
- Lowered cholesterol and blood pressure
Before Beginning an Exercise Program

1. Have client consult primary care physician.
2. If determined necessary (ACSM guidelines) have client undergo a graded exercise test.
3. Determine the effects of all client’s medications on exercise.
4. Perform a complete medical and exercise history prior to participation.
5. Consult other health care professionals such as MD, PT, OT, or RN should you have questions regarding medical status, condition, or medication.
Safety Considerations

- Have client stop exercise if he/she experiences pain, discomfort, nausea, dizziness, lightheadedness, chest pain, irregular heart beat, shortness of breath, or clammy hands.
- Have client drink plenty of fluids, especially water.
- Make sure client wears appropriate clothing.
- Follow principle of specificity-in order to improve function of a system through exercise, the exercise must stimulate that system.
- A comprehensive program should address all components of fitness (i.e., cardio, strength, flexibility, balance, etc.).
Coronary Artery Disease Risk Factor Thresholds (ACSM)

- Family history-MI, revascularization, or sudden death before 55 Males/65 females
- Cigarette smoking-current or quit less than 6 mo.
- Hypertension-140/90 or greater observed on 2 separate occasions, or antihypertensive medication
- Hypercholesterolemia-Total serum cholesterol >200mg/dl or HDL <35 mg/dl or LDL >130 mg/dl
- Impaired fasting glucose-fasting ≥110mg/dl
- Obesity-BMI ≥30 (kg/m²) or waist girth >100 cm
- Sedentary lifestyle-not meeting 30 minutes PA most days of the week
ACSM Risk Stratification

- Low risk- M<45/W<55, asymptomatic, no more than 1 risk factor
- Moderate Risk- M\geq 45/W\geq 55, 2 or more risk factors
- High Risk-one or more signs or symptoms of cardiovascular or pulmonary disease (shortness of breath at rest or mild exertion, dizziness/syncope, intermittent claudication, etc.) or known cardiovascular, pulmonary, or metabolic disease
# Medical Examination and Exercise Testing Prior to Participation

<table>
<thead>
<tr>
<th></th>
<th>Low Risk</th>
<th>Moderate Risk</th>
<th>High Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Moderate Exercise</strong></td>
<td>Not Necessary</td>
<td>Not Necessary</td>
<td>Recommended</td>
</tr>
<tr>
<td><strong>(3-6 METS)</strong></td>
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</tr>
<tr>
<td><strong>Vigorous Exercise</strong></td>
<td>Not Necessary</td>
<td>Recommended</td>
<td>Recommended</td>
</tr>
<tr>
<td><strong>(&gt;6 METS)</strong></td>
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</tbody>
</table>
Barriers to Physical Activity

• Surgeon General’s Report and many other reports recommend walking 30 minutes a day.
• For some individuals, this may not be possible:
  – Can’t walk
  – Difficulty with balance
  – Painful to walk
  – Unsafe neighborhoods
  – Uneven sidewalks
  – No sidewalks
  – Must be supervised
  – Cost
  – Transportation
• SGR and various other physical activity guidelines all recommend 30 minutes a day most days of the week.

  – Does this apply to people with mobility impairments?

  – Will there be similar physiological benefits equal to non-disabled populations?
SGR Recommended Activity for People with Disabilities

SGR Recommended Activity: Wheel for 30-40 minutes

Problems with SGR Recommendations:

- High rate of shoulder pain and injury among wheelchair users.
- Carpal tunnel syndrome is a common problem.
- Many wheelchair users are severely deconditioned.
- Where does one practice wheeling for 30-40 minutes?
- Finding flat terrain to “wheel” may be difficult.
Effective Physical Activity Programs

Must address not only aspects of the disability/disablement, but also several other factors and interactions between the person and environment.
Long-Term Disabilities

LTD are defined as conditions that span over the person’s lifetime and have been around for more than 5 years.

- Fitness Instructors must gain knowledge in the field of disability.
- Disabilities are categorized by site of injury from brain to periphery.
- Disabilities can also be classified by function.
- While there are many different types of LTD, only the most common neurological disabilities will be discussed.
Nonprogressive Physical Disabilities of the Nervous System

• Cerebral Palsy - a group of disorders classified under the same heading.

Associated Conditions

– lesion in the upper motor neurons within the brain, which regular neuromuscular function.
– Specific site of the lesion determines the nature of the disorder.
– Can occur before, during, or after birth.
– A nonprogressive disorder.
– Considered a developmental disability.
– Usually affects motor, speech, growth, and cognition.
– Primitive reflexes may be present.
Common Terms

- **Paresis** - partial weakness to one or more limbs.
- **Plegia** - greater involvement one or more limbs than paresis, often associated with paralysis.
- **Paralysis** - complete loss of motor control.
- **Muscle tone** - amount of tension in a muscle group.
- **High tone** - often referred to as spasticity or hypertonicity; excess tone in a muscle group.
- **Low tone** - often referred to as flaccidity or hypotonia; decreased amount of tone in a muscle group.
Common Terms

- **Spasticity** - an involuntary increase in muscle tone.
- **Functional Muscle Mass** - muscle mass that still has nerve innervation.
- **Contracture** - shortening of a muscle group and tendon usually observed in persons with spasticity.
- **Progressive Disorder** - condition that worsens over time.
- **Exacerbation** - a flare-up in which symptoms deteriorate or worsen in a particular condition.
- **Remission** - Symptoms stabilize or slightly improve.
Stroke
Types of Strokes

- 80% to 90% are ischemic.
  - Blood flow to the brain is interrupted by a fatty deposit (thrombosis) or a clot in the artery (emboli).
- 10% to 20% are hemorrhagic.
Hemorrhagic Strokes

– Referred to as intracerebral or subarachnoid depending on the location of injury.
– Hypertension is the most common cause of brain hemorrhage.
– Other possible causes are ruptured aneurysm, drug use, tumor.
Ischemic Strokes

- **Thrombotic infarction** occurs when a thrombus forms on an atherosclerotic plaque (Hypercoagulable states may cause this).
- **Embolic infarction** results when an embolus occludes an artery or arteriole.
- **Hemodynamic infarction** occurs when there is a severe stenosis or occlusion of a proximal artery to the brain reducing blood flow (perfusion). Most common in carotid artery.
Extent of Involvement

• Clinical features depend on the location and severity of the brain infarct or hemorrhage.
• Stroke causes upper motor neuron injury, resulting in the following complications:
  – Hemiparesis -- reduces the number of recruitable motor units during activity.
  – Paralysis -- complete loss of function
  – Spasticity -- hyperactive stretch reflexes
  – Sensory-Perceptual Dysfunction -- balance and motor coordination problems.
Symptoms of Stroke

- Sudden weakness, numbness or paralysis of the face, arm or leg.
- Sudden dimming or loss of vision.
- Difficulty speaking.
- Sudden, severe headache with no apparent cause.
- Unexplained dizziness, particularly if it occurs with above symptoms.
- Vomiting (hemorrhagic).
- Altered level of consciousness (more severe with hemorrhagic).
What Parts of the Brain Are Affected by Stroke?
What Are the Effects of Stroke?

- Right Brain

- Paralyzed Left Side
- Spatial-Perceptual Deficits
- Quick, Impulsive Behavioral Style
- Memory Deficits
What Are the Effects of Stroke?

- **Left Brain**

  - Paralyzed Right Side
  - Speech-Language Deficits
  - Slow, Cautious Behavioral Style
  - Memory Deficits

NCPAD
National Center on Physical Activity and Disability
www.ncpad.org ~ ncpad@uic.edu ~ 1-800-900-8086
Comorbidities Associated with Stroke

- Hypertension
- Hyperlipidemia
- Coronary heart disease
- Diabetes
- Obesity
- Pulmonary dysfunction (from smoking)
Secondary Conditions Associated with Stroke

- Paralysis or paresis (hemiplegia/hemiparesis)
- Decreased mobility
- Low fitness
- Depression
- Social isolation
Exercise Testing Guidelines for Stroke Participants

• Obtain medical history prior to GXT.
• Complete blood and urine analysis prior to testing (e.g., anemia, low potassium, kidney failure).
• Get physician consent (recommend a physical exam prior to test) and participant consent.
• Determine resting blood pressure in supine, sitting and standing positions to evaluate orthostatic hypotension.
• GXT must be completed with a physician present.
• Submaximal testing is not recommended (e.g., YMCA bicycle test).
Exercise Testing Guidelines

- Use a stationary cycle ergometer or arm ergometer in place of a treadmill, unless safeguards are provided.
- Call participant night before test to remind them of procedures (e.g., fasting 4 hrs. prior to test).
- Recommended protocol: ramp, warmup @ 10 W, begin at 20 W, and increment should be 10 W.
- Use assistive devices to keep hemiparetic side attached to bike.
- Take blood pressure measurements on non-hemiparetic side (diameter of the artery is reduced on hemiparetic side).
- Modification of BP for obese clientele: use thigh cuff – cuff (black portion) must cover 2/3’s of arm circumference.
- Use a high quality stethoscope – greater sensitivity.
**Exercise Testing Guidelines**

- Follow ACSM’s *Guidelines for Exercise Testing and Prescription (7th edition)* criteria:
  - Box 3-5 – Contraindications to exercise testing; and
  - Box 5- 2 – Termination of an exercise test.
- Clients who do not pass test should be recommended for a cardiac rehabilitation program.
Exercise Prescription Guidelines

• Use SOAP note and daily exercise prescription chart.
  • S – subjective
  • O – objective
  • A – assessment
  • P -- prescription
Things to Observe In Stroke Clients

- Forget or ran out of blood pressure medication.
- High (> 250 mg/dl) or low (< 100 mg/dl) blood glucose level.
- Dehydrated.
- Not feeling well – physically or emotionally.
- Returning from the flu.
Intensity Level

• Should be based on exercise test.
• Start program gradually.
• Use RPE along with heart watch monitor.

  – Intermittent exercise suggested at beginning of program
Exercise Guidelines
Cardiovascular Component

• **Special Concern:**
  Participants with an abnormal blood pressure response during the exercise test:
  Systolic BP > 200 mm Hg
  Diastolic BP > 110 mm Hg

Use Rate Pressure Product (RPP):
  \[ RPP = \frac{\text{Systolic BP} \times \text{HR}}{100} \]

Example:
  \[ 180 \times \frac{130}{100} = 234 \]

RPP must be < 200 to allow exercise to continue.
Summary of Cardiovascular Exercise Guidelines

• RPP should not exceed 200.
• Stop activity if BP reaches or exceeds 220/110.
• Resting SBP < 200 mm Hg.
• DBP must be < 100 mm Hg.
• Record BP, HR, and RPE 3X during session.
• Begin with intermittent exercise.
Resistance Training Guidelines - Stroke

- Must have a stable blood pressure before participation.
- Monitor blood pressure.
- Assume that most stroke survivors have hypertension.
- Strengthen hemiplegic or hemiparetic side.
- Maintain physical independence.
Strength Training Guidelines

- 70% of 10-RM for 1 set of 15-20 reps.
- When participant is able to complete 25 reps for 2 consecutive sessions with correct technique, weight is increased by approximately 10% of their 10-RM.
Flexibility Guidelines

• Design exercises to improve hemiparetic side.
• Examples:
  • Across-the-body arm stretches
  • Behind the back arm stretches
  • Standing calf and hamstring stretches.
Case Study- Stroke
Multiple Sclerosis
Multiple Sclerosis

- A degenerative inflammatory disease of the CNS, involving the brain, optic nerve, and spinal cord.
- Demyelination along the CNS leads to less controlled and coordinated movements.
- ANS changes become present in heart rate and blood pressure.
- Known as a demyelinating condition of the central nervous system.
- Myelin sheath is slowly destroyed.
- Characterized by periods of exacerbation and remission.
Epidemiology of MS

- One of the most common neurological diseases of young adults.
- Onset: most often between 20-40 yrs (90% of cases diagnosed between 16 and 60).
- In the U.S., MS has been diagnosed in 350,000 people.
- Diagnosis (MRI) is determined from the presence or lack of exacerbations and remissions of neurological symptoms.
- Greater risk in temperate zones (3/100,000) vs. tropical environments (1/100,000).
- Women affected more than men (2:1).
Pathophysiology

- May be caused by a virus that occurs before age 16 and lies dormant – something (not sure what) triggers the disease years later.
- Disease of the CNS where there are multiple areas of inflammatory demyelination.
- Autoimmune disease – activated macrophages attack and digest myelin.
- Lesions of inflammatory demyelination can be present in the cerebral hemispheres, brain stem, and spinal cord.
Normal Conduction in Myelinated Nerve Fiber

Source: [http://medlib.med.utah.edu/kw/ms/mml/ms_pathology03.html](http://medlib.med.utah.edu/kw/ms/mml/ms_pathology03.html)
This slide shows abnormal conduction in a nerve fiber in demyelinating diseases.

Source: http://medlib.med.utah.edu/kw/ms/mml/ms_pathology04.html
Area of Demyelination in Cerebellum – MRI scan

Red arrows point at the area of demyelination in cerebellar hemisphere.

source: [http://medlib.med.utah.edu/kw/ms/mml/ms_cerebellum.html](http://medlib.med.utah.edu/kw/ms/mml/ms_cerebellum.html)
Demyelination in the Cervical Spinal Cord – MRI Scan

Red arrows point at 2 areas of demyelination in the cervical spinal cord in a patient with multiple sclerosis.

Source: [http://medlib.med.utah.edu/kw/ms/mml/ms_cspine01.html](http://medlib.med.utah.edu/kw/ms/mml/ms_cspine01.html)
Clinical Features

- Profound fatigue.
- Motor fatigue, which develops with continued physical activity.
- Marked decrease in heat tolerance.
- Blurring of vision in one or both eyes may occur during exercise.
- Optic neuritis (painful blurring or loss of vision) – most begin to recover within 6 weeks.
- Weakness starts in lower extremities and works its way to upper extremities.
- Spastic paraparesis + ataxia – “spastic ataxic syndrome.”
Clinical Features

• Neurogenic bladder (any dysfunction of the urinary bladder)
  – Urinary frequency and urgency
  – Urinary incontinence
  – Nocturia

• High incidence of UTIs
Multiple Sclerosis

- Secondary conditions
  - Ataxia
  - Weakness
  - Fatigue
  - Sensitivity to temperature
  - Visual disturbances
  - Spasms
  - Bladder control
Patterns of Multiple Sclerosis

• Varying degrees of severity:
  – **Benign** -- several attacks (often affecting vision) followed by good recovery and long periods of remission.
  – **Relapsing remitting** -- periods of exacerbation and good functional recovery for several years followed by a long asymptomatic period for many years.
  – **Relapsing progressive**-- periods of exacerbation that may, but do not necessarily, alternate with periods of remission; disability accumulates with time.
  – **Chronic progressive** -- slow, progressive decline in function with no periods of remission.
  – Exacerbations treated with high doses of steroids (prednisone).
Exercise Response in MS

- Acute: Comparison of VO2 max against norm-referenced standards revealed that 75% fell into the low fitness category.
- Aerobic exercise endurance (i.e., time to fatigue) varies greatly among clients with MS.
- Wide variability among clients in terms of exercise duration capability.
- Can increase muscle strength and endurance.
- Petajan: 22% increase in VO2 max and a 48% increase in physical work capacity (lower gains in severely impaired -- +7% in VO2 max).
<table>
<thead>
<tr>
<th>Methods</th>
<th>Measures</th>
<th>Endpoints*</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Aerobic</strong></td>
<td></td>
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<tr>
<td>Schwinn AirDyne™ Recumbent or semi-recumbent cycle (17 watts/min) Ramp protocol (12-25 watts/3-min stage) Discontinuous protocol (3-5 min/stage)</td>
<td>• Expired gas analysis • HR, rate pressure product • RPE (6-20) • BP</td>
<td>• VO₂peak, METs • Peak HR • Volitional fatigue • SBP &gt; 250 mmHg or DBP &gt; 115 mmHg • Hypotensive response</td>
<td>• VO₂peak, METs, and RPE are the best predictors for developing an exercise program because of possible abnormal cardioacceleration responses. • Attenuated BP response may occur.</td>
</tr>
<tr>
<td><strong>Endurance</strong></td>
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<tr>
<td>Air-Dyne™ or cycle ergometer 6- and 12-min walk tests</td>
<td>• Distance</td>
<td>• Note time, distance, symptoms at rest stops</td>
<td>• Also a good indicator for developing an exercise program.</td>
</tr>
<tr>
<td><strong>Strength</strong></td>
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<td></td>
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<tr>
<td>Isokinetic</td>
<td>• Peak power output and peak torque of major muscle groups</td>
<td></td>
<td>• Has been shown to have moderate correlation with aerobic power.</td>
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<tr>
<td><strong>Flexibility</strong></td>
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<td></td>
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<tr>
<td>Goniometry</td>
<td>• Angles at full extension/flexion</td>
<td></td>
<td>• Helpful in explaining gait abnormalities.</td>
</tr>
<tr>
<td><strong>Neuromuscular</strong></td>
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<tr>
<td>Gait analysis Balance (Berg balance scale) Functional reach</td>
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<td></td>
<td>• Used to determine and quantify asymmetry, muscle weakness or paresis, and functional changes.</td>
</tr>
</tbody>
</table>

*Measurements of particular significance; do not always indicate test termination.
<table>
<thead>
<tr>
<th>Medications</th>
<th>Special Considerations</th>
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</thead>
<tbody>
<tr>
<td>The following drugs are prescribed for relapsing-remitting MS. It will reduce the severity and number of exacerbations.</td>
<td></td>
</tr>
<tr>
<td>• Amantadine: May temporarily reduce fatigue.</td>
<td></td>
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<tr>
<td>• Baclofen: High dosage may cause muscle weakness and fatigue.</td>
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</tr>
<tr>
<td>• Amitriptyline, fluoxetine, hyoscyamine sulfate: May cause muscle weakness.</td>
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<tr>
<td>• Prednisone: May cause muscle weakness, reduced sweating, hypertension, diabetes, and/or osteoporosis.</td>
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<tr>
<td>• Interferon beta-1a (Avonex): May produce flu-like symptoms.</td>
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<tr>
<td>• Interferon beta-1b (Betaserlon): May produce flu-like symptoms.</td>
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<tr>
<td>• Glateramer acetate (Copaxone).</td>
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<tr>
<td>• Prediction of VO₂peak from submaximal performance has been shown to result in &gt; 15% error in this population.</td>
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<tr>
<td>• Patients may experience foot drop, affecting exercise capacity.</td>
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<tr>
<td>• Reduced sensation is variable over the extremities; may be symmetrical or asymmetrical. Sensations of numbness and tingling are also common.</td>
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<tr>
<td>• Paresis and paralysis are more prevalent in lower extremities and antigravity muscles.</td>
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<tr>
<td>• Muscle imbalance may exist between agonist and antagonist muscles.</td>
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<tr>
<td>• Some clients may have significant cognitive deficit. This may require careful instructions and cueing during testing. RPE scale may be difficult for them to understand.</td>
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</tr>
<tr>
<td>• Because of difficulty to adjust to temperature change, the testing room should be kept cool or therm neutral.</td>
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</tr>
<tr>
<td>• Incontinence is common. Opportunities for voiding before and during testing should be planned.</td>
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</tr>
<tr>
<td>• Morning is usually the optimal time to test.</td>
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</tr>
<tr>
<td>• If possible, recumbent cycling is desirable over upright cycling because of balance problems. Toe clips or heel straps are needed because of ankle/foot clonus or leg spasticity.</td>
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</tr>
<tr>
<td>• There are no studies examining the effects of these drugs on the exercise response. Flu-like symptoms may reduce exercise tolerance.</td>
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<tr>
<td>• Consider controlling resistance in arms and legs separately to minimize premature fatigue.</td>
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</tr>
</tbody>
</table>
Exercise Guidelines for MS

• Avoid embarrassing situations related to urinary incontinence.
• Keep close record of performance on static and dynamic balance tasks and make balance an important part of the exercise prescription.
  – Swiss ball, balance beam, balance boards, etc.
• Avoid overheating.
• Keep pool temperatures adequately cool for participant (i.e., under 84 degrees).
• Monitor fatigue (i.e., good evaluation instrument: Fatigue Severity Scale)
Exercise Guidelines for MS

- Maintain proper hydration.
- Avoid excessive overheating and work out in comfortable temperatures.
- Use appropriate gloves, straps, ace bandages, etc. to keep feet and hands on exercise machines.
- Theracycle might be a good option.
Resistance Training Guidelines for Multiple Sclerosis

• Persons with MS have an attenuated or absent sweating response. Avoid for warm environments or overheating.
• Swimming is an excellent modality for strength enhancement.
• Monitor balance. Progressive MS will likely lead to a higher incidence of falls as the disease progresses.
• Sensory deficits (tactile and proprioception) may make using free weights dangerous.
Flexibility

• Tight muscle groups: hip flexors, hamstrings, and triceps surae, lateral trunk flexibility.

• Watch for foot drop associated with dorsiflexor weakness – also presents a higher risk of falling.
## Multiple Sclerosis: Exercise Programming

<table>
<thead>
<tr>
<th>Modes</th>
<th>Goals</th>
<th>Intensity/Frequency/Duration</th>
<th>Time to Goal</th>
</tr>
</thead>
</table>
| **Aerobic** | • Increase or maintain cardiovascular function | • 60-85% peak HR  
• 50-70% VO<sub>2</sub>peak  
• 3 days/wk  
• 30 min/session | 4-6 mo       |
| Cycling    |                                        |                                              |              |
| Walking    |                                        |                                              |              |
| Swimming   |                                        |                                              |              |
| **Strength** | • Increase functional capacity          | • Do not perform on endurance training days |              |
| Weight machines |                                    |                                              |              |
| Free weights |                                        |                                              |              |
| Isokinetic machines |                                |                                              |              |
| **Flexibility** | • Increase or maintain ROM      | • Perform before strength or endurance training |              |
| Stretching                  |                                              | • 5-7 days/wk                              |              |

### Medications
- See exercising testing table.
- There are no studies examining the effects of these drugs on exercise response.
- Flu-like symptoms may reduce exercise tolerance.

### Special Considerations
- Incontinence is common. Opportunities for voiding before and during testing should be planned.
- Morning is usually the optimal time to test.
- If possible, recumbent cycling is preferred over upright cycling because of balance problems. Toe clips or heel straps are needed because of ankle/foot clonus or leg spasticity.
- May experience attenuated HR or BP response during exercise. May have attenuated or absent sudomotor response.
- Maintaining hydration is critical.
- Secondary medical problems are common, with hypertension and obesity being common CAD risk factors.
- Much of the disability incurred is also related to secondary deterioration from sedentary lifestyle.
- Non-weight-bearing activities should be relegated to clients having balance problems, orthopedic complications, or sensory loss to the lower extremities.
- Muscle weakness in the lower extremities often causes premature fatigue. Symptoms may change over the course of the exercise program and may require adjustments of intensity and duration.
- Depression may affect adherence, so constant reinforcement and counseling are necessary for some clients.
<table>
<thead>
<tr>
<th>Mode of Exercise/Activity</th>
<th>General Goals</th>
<th>Intensity/Frequency/Duration</th>
<th>Special Consideration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Activity</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>- Activities of Daily Living</td>
<td>- Increase daily activity energy expenditure</td>
<td>- 30 minutes of accumulated physical activity each day on most days</td>
<td>- Strategies for energy conservation may be necessary.</td>
</tr>
<tr>
<td>- Built-in Inconveniences</td>
<td>- Increase cardiovascular function</td>
<td>- 60–75% HR_{peak} /50–65% VO_{2peak}</td>
<td></td>
</tr>
<tr>
<td>- Leisure Activities and Hobbies</td>
<td>- 3 sessions/week</td>
<td>- 1 30-min session or 3 10-min sessions/day</td>
<td></td>
</tr>
<tr>
<td>Aerobic and Endurance</td>
<td></td>
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</tr>
<tr>
<td>Exercise</td>
<td>- Increase general muscle strength</td>
<td>- Perform on nonendurance training days.</td>
<td>- Air temperature should be kept cool; fans may be helpful; therapeutic swimming pool water temperature is too warm.</td>
</tr>
<tr>
<td>- Cycling</td>
<td>- Improve muscle tone</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>- Walking</td>
<td>- Equalize agonist/antagonist strength</td>
<td>-</td>
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<tr>
<td>- Water aerobics</td>
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<tr>
<td>- Chair exercise</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Strength Training</td>
<td>-</td>
<td>-</td>
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<tr>
<td>- Resistance training</td>
<td>-</td>
<td>-</td>
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<tr>
<td>- Elastic bands</td>
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<td>-</td>
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<tr>
<td>- Free weight</td>
<td>-</td>
<td>-</td>
<td></td>
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<tr>
<td>- Weight machines</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>- Pulley weights</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Flexibility (Stretching)</td>
<td>- Increase joint range of motion</td>
<td>- Perform daily for short periods, preferably more than once per day if fatigue occurs.</td>
<td>- With any upper-extremity sensory deficit, free weights should not be used.</td>
</tr>
<tr>
<td>- Passive range of motion (ROM)</td>
<td>- Counteract effects of spasticity</td>
<td>- Exercises should be performed in a seated position when possible.</td>
<td></td>
</tr>
<tr>
<td>- Active ROM</td>
<td>- Improve balance</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>- Yoga</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>- Tai Chi</td>
<td>-</td>
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<td></td>
</tr>
</tbody>
</table>
Case Study-MS
Cerebral Palsy
Cerebral Palsy

- Cerebral Palsy - a group of disorders that affect control of movement.

Features:
- Lesion in the upper motor neurons within the brain, which regulate neuromuscular function.
- Specific site of the lesion determines the nature of the disorder.
- Can occur before, during, or after birth.
- A nonprogressive disorder.
- Considered a developmental disability.
- Usually affects motor, speech, growth, and cognition.
- Primitive reflexes may be present.
Different Forms of CP

• **Spastic cerebral palsy** – 70-80% of all cases.
  – Muscles are stiffly and permanently contracted.
  – Subdivided into:
    • Spastic hemiplegia
    • Spastic diplegia
    • Spastic paraplegia
    • Spastic quadriplegia

• **Athetoid cerebral palsy** (also called *dyskinetic*) – 10-20% of all cases
  – Characterized by uncontrolled, slow, writing, movements of the hands, feet, arms, legs, and in some cases, the muscles of the face and tongue; disappears in sleep; jerky movements also exhibited.
  – Dysarthria also exhibited – problems coordinating the movements associated with speech.
Scissors Gait
Hemiplegic Gait
Different Forms of CP

• **Ataxic cerebral palsy** – 5-10% of all cases
  – Affects balance and coordination.
  – May walk unsteadily with a wide-based gait.
  – Difficulty with quick or precise movements.
  – May also have intention tremor.

• **Mixed forms** – Common to have symptoms of more than one form of cerebral palsy.
  – Most common combination includes spasticity and athetoid movements.
Cerebral Palsy

Classification:

Topographical
– Categorized based on affected area of body -- using “plegia” as a suffix.
– Monoplegia
– Paraplegia
– Hemiplegia
– Quadriplegia
– Diplegia
Classification:

Neuromotor

– Considers site of the lesion in the brain and associated muscular involvement (e.g., spastic, athetoid)

– Spastic CP -- 60-70% of all cases.
  • Causes hypertonicity
    – Affected muscles: flexors, adductors, internal rotators
    – Postural problems
Left Brain Damage

Right brain damage
- Weak or paralyzed right side
- Speech/language deficits
- Behavioral style: slow, cautious
- Memory deficits in language

Left brain damage
- Weak or paralyzed left side
- Spatial/perceptual deficits
- Behavioral style: quick, impulsive
- Memory deficits in performance

NCPAD National Center on Physical Activity and Disability
www.ncpad.org ~ ncpad@uic.edu ~ 1-800-900-8086
<table>
<thead>
<tr>
<th>Class description</th>
<th>Locomotion</th>
<th>Object control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe spasticity and/or athetosis with poor functional range of motion and strength in all extremities; poor to nonexistent trunk control</td>
<td>Motorized wheelchair or assistance for mobility</td>
<td>Only thumb opposition and one finger possible; can grasp only beanbag</td>
</tr>
<tr>
<td>Severe to moderate spastic and/or athetoid quadriplegic; poor functional strength in all extremities, and poor trunk control; classified as II lower if one or both lower extremities are functional; otherwise, classified as II upper</td>
<td>Propels wheelchair on level surfaces and slight inclines (lower class II with legs only); sometimes may be able to ambulate short distance with assistance</td>
<td>Can manipulate and throw a ball (II upper)</td>
</tr>
<tr>
<td>Moderate quadriplegic or triplegic; severe hemiplegia; fair to normal strength in one upper extremity</td>
<td>Can propel wheelchair independently but may walk a short distance with assistance or assistive devices</td>
<td>Normal grasp of round objects but release is slow; limited extension in follow-through with dominant arm</td>
</tr>
<tr>
<td>Moderate to severe diplegic; good functional strength and minimal control problems in upper extremities and torso</td>
<td>Assistive devices used for distances; wheelchair is usually used for sport</td>
<td>Normal grasp is seen in all sports; normal follow-through is evident when pushing a wheelchair or throwing</td>
</tr>
<tr>
<td>Moderate to severe diplegic or hemiplegic; moderate to severe involvement in one or both leg; good functional strength; good balance when assistive devices are used</td>
<td>No wheelchair; may or may not use assistive devices</td>
<td>Minimal control problems in upper limbs; normal opposition and grasp seen in all sports</td>
</tr>
<tr>
<td>Moderate to severe quadriplegic (spastic/athetoid or ataxic); fluctuating muscle tone producing involuntary movements in trunk and both sets of extremities; greater upper-limb involvement when spasticity/athetosis present</td>
<td>Ambulates without aids; function can vary; running gait can show better mechanics than when walking</td>
<td>Spastic/athetoid grasp/release can be significantly affected when throwing</td>
</tr>
<tr>
<td>Moderate to minimal spastic hemiplegic; good functional ability on nonaffected side</td>
<td>Walks and runs without assistive devices but has marked asymmetrical action; obvious Achilles tendon shortening when standing</td>
<td>Minimal control problems with grasp and release in dominant hand; minimal limitation seen in dominant throwing arm</td>
</tr>
<tr>
<td>Minimal hemiplegic, monoplegic, diplegic, or quadriplegic; may have minimal coordination problems; good balance</td>
<td>Runs and jumps freely with little to no limp; gait demonstrates minimal or no asymmetry when walking or running; perhaps slight loss of coordination in one leg or minimal Achilles tendon shortening</td>
<td>Minimal incoordination of hands</td>
</tr>
</tbody>
</table>

Associated Conditions

- Intellectual disability
- Visual impairment. Most common type is strabismus.
- Auditory impairment.
- Seizures
- Speech impairment
Secondary Conditions

• Physical Stresses
  – Increasing joint and muscle pain
  – Declining mobility due to bone loss and muscle atrophy
  – Wear and tear on joints
  – Decreased endurance
  – Pressure sores and skin breakdown
Secondary Conditions

• Social Stresses
  – Extra “energy” required to ambulate leaves less energy left for social activities.
  – Increased social isolation due to impairment.
  – May need to reduce working hours or give up employment.

• Psychological Stresses
  – Depression, sometimes associated with loss of independence.
Exercise Testing Guidelines for Persons with Cerebral Palsy

• **Cardiovascular**
  - Wheelchair ergometer for wheelchair users (difficult to calculate or control work load)
  
  *Or*

  - Arm ergometer – easier to control workload

- Difficulty Testing Persons with CP:
  may increase spasticity and athetosis and impair coordination
Exercise Testing - CP

• Cardiovascular
  – Starting power outputs – 0-15 W at 30-50 rpm and increasing 5-10 W every 1-2 min.
  – Make sure client is in a stable position
  – Be very cautious if you use straps to attach the client’s hand to the handle.

Other testing devices:
  Nu-Step Recumbent Stepper – greater recruitment of musculature; can increase workload without increasing cadence.
  Schwinn Air-Dyne – cannot increase workload without increasing cadence (rpm) which may increase spasticity and impair coordination.
Exercise Testing - CP

• Cardiovascular
  – Treadmill – great testing device but may be limited in persons with CP due to impairments in balance and coordination.
  – If a treadmill is used, protect against increased spasticity and use a spotter at all times.
• Metabolic data – mouthpiece may be a problem; use mask but make sure you maintain a tight seal.
Exercise Testing - CP

- Muscular Strength and Endurance
  - Old concept – increases spasticity – not true
  - Co-contraction may offset strength in tested muscle groups (agonists).
  - Measure ROM in tested muscle groups
  - Test muscle groups unilaterally (may be more spasticity on one side).
  - Focus on stability, coordination, ROM, and timing.
  - Adaptations: wide benches, low seats, trunk and pelvic strapping.
  - Machines are safer than free weights and provide greater “fluidity” to the movement.
Exercise Testing - CP

• Muscular Strength and Endurance
  – Use a metronome to ensure appropriate fluidity.
  – Use non-slip handgrips and gloves (if necessary).
  – Always provide adequate practice prior to testing.
Exercise Testing - CP

- Flexibility – Important to measure each side separately.
- Balance – measure both sitting and standing (dynamic and static).
Resistance Training Guidelines for Cerebral Palsy

1. Spasticity of Hip and Shoulder Adductors
   a. Strengthen Abductors while concentrating on flexibility and maximum ROM.
   b. Adductors may also be weak.
2. Make sure there is no history of hip dislocation.
3. Persons with CP have a higher prevalence of osteopenia and osteoporosis.
4. Hemiplegia: focus on weak side if muscle groups are still functional or partially functional.
5. Develop static and dynamic balance.
6. Work on performing the smoothest motion possible but understand that “jerkiness” may not be avoided due to hyperactive stretch reflexes and a lack of reciprocal inhibition.
General Exercise Guidelines

• Use velcro straps to keep hand and foot placement on machines.
• Check for contractures and limit movement to within capability of client – overstretching a contracture could cause injury.
• Be aware that there is a higher incidence of osteoporosis.
• Have towels available for possible drooling.
• Do not confuse speech impairment with cognitive disability.
Exercise Programming for CP

- Fitness levels of persons with cerebral palsy are extremely poor – See Rimmer JH. Physical fitness levels of persons with cerebral palsy. *Develop Med and Child Neurol* 2001; 43: 208-212.
- Exercise program may have to be adapted for level of cognition (high incidence of mental retardation)
- Pain and fatigue are prevalent secondary conditions, particularly among older individuals with CP.
- Use non-weight bearing machines if pain is an issue. (walking for exercise may increase pain).
Exercise Programming for CP

• Watch for treadmill walking since many ambulatory clients have difficulty with dorsiflexion (tight plantar flexors).
• May need to strengthen dorsiflexors (i.e., tibialis anterior) and stretch plantar flexors (i.e., triceps surae).
• May also need to observe gait and target adductor tightness (spasticity) and strengthen weak abductors.
• All muscle groups including those with spasticity need to be strengthened.
• Spastic muscles respond best to slow, controlled movements.
Case Study-Cerebral Palsy
Parkinson’s Disease
Parkinson’s Disease

- **Parkinson’s Disease**: a progressive, degenerative neurological disorder associated with the central nervous system resulting in the decrease, or abnormal activity, of neurotransmitter systems.

**Features:**

- Reduction in the neurotransmitter dopamine (DA)
- Primarily in substantia nigra, a component of the basal ganglia
- Usually occurs in individuals over the age of 50
- No known cause; however, both genetics and environment (exposure to toxins) are thought to be factors
- Other factors that may be contributing mechanisms are aging, autoimmune responses, and mitochondrial dysfunction
- Symptoms do not occur until there is greater than 80% loss of dopaminergic cells
Pathology of Parkinson’s Disease

Source: www.wemove.org
Dopamine Pathways:
Nigro-striatal

Striatum
(basal ganglia)

Substantia nigra

Dopamine Pathways
(meso-limbic; meso-cortical)

Cortex

Limbic

Midbrain
(meso)

Source: http://www.pallidotomyc.com/pathology.html
Different types of Parkinson’s

Idiopathic Parkinson’s disease (or Primary)
• Most common type
• Characterized by damage (unknown) to the nigrostriatal pathway and the presence of Lewy bodies
• Approximately 400,000 people affected in the U.S.

Secondary parkinsonism
• Neurological syndrome displaying motor symptoms similar to IDP
• Damage to nigrostriatal system has been identified
• Causes include postencephalitic, drug-induced, toxic, traumatic, metabolic, and neoplastic.
Types of Parkinson’s cont.

Parkinsonism-plus syndromes

• Due to multiple system degenerations or atrophies

• Shy-Drager Syndrome
  – Disturbance of sweating, bladder, and sexual dysfunction
Forms of IPD

• Tremor predominant
  – More severe tremor
  – Earlier age of onset
  – Less cognitive impairment
• Postural instability-gait difficulty (PIGD) predominant
  – Greater gait and postural instabilities
  – Increased episodes of falling and/or freezing
• Akinetic-rigidity predominant
  – Significant decrease or complete lack of movement (akinesia) along with rigidity
Pharmacology

• Dopaminergics
  – Levodopa, levodopa/carbidopa, amantadine, pergolide, and bromocryptine

• Anticholinergics
  – Benztropine, trihexyphenidyl

• MAO-B inhibitors
  – Selegilene

• COMT inhibitors
  – Entacapone, tolcapone
Secondary Conditions

- **Tremors**
  - Rest & action
- **Bradykinesia**
  - Ability to move fingers, hands, arms, or legs rapidly is drastically reduced
- **Rigidity**
  - Often begins in the neck & shoulders and spreads to the trunk and extremities
- **Postural Instability**
  - Increased kyphosis and flexed knees & elbows and adducted shoulders
Standing Posture

Gait (secondary condition)
- Short, shuffling steps
- Heel-toe pattern lost
- Festination-propulsion forward with quick steps
- Arm swing greatly decrease or absent
- Freezing
- Postural reflexes absent (falls)
Secondary Conditions

• Segmental movements in the joints
  – Especially in the vertebrae
  – Difficulty isolating movements such as rolling from side-to-side (getting out of bed), rotating trunk (getting out of a car) and arising from a chair

• Other functional impacts
  – Fastening buttons
  – Writing (micrographia)
  – Speech (dysphagia)
  – Swallowing (sialorrhea-drooling)

• Depression
• Muscle atrophy and weakness
• Dementia
• Urinary Incontinence
• Dyskinesia (uncontrollable abnormal movements)
• Dystonia (muscle cramps, and unusual posturing)
• Chorea (twisting movements)
• On/Off Phenomenon
Before Exercise

• It is recommended that balance (static & dynamic), gait, general mobility, range of motion & flexibility, and manual muscle testing be performed.

• Consult client’s neurologist and network with a team of rehabilitative specialist (PT, OT, Speech Therapist)
Prior to Aerobic Exercise Testing

- Follow the absolute and relative contraindications for exercise testing as outlined by ACSM.
<table>
<thead>
<tr>
<th>Methods</th>
<th>Measures</th>
<th>Endpoints*</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Aerobic</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leg or arm ergometer</td>
<td>• 12-lead ECG, HR</td>
<td>• Serious dysrhythmias</td>
<td>• Prevalence of dysrhythmias is high.</td>
</tr>
<tr>
<td></td>
<td>• BP</td>
<td>• &gt;2mm ST-segment depression or elevation</td>
<td>• Use HR response to determine impact of medications.</td>
</tr>
<tr>
<td></td>
<td>• VO₂ max, METs</td>
<td>• Ischemic threshold</td>
<td>• Autonomic dysfunction is common.</td>
</tr>
<tr>
<td></td>
<td>• RPE (6-20)</td>
<td>• T-wave inversion with significant ST change</td>
<td>• VO₂ max and METs useful in prescribing exercise.</td>
</tr>
<tr>
<td><strong>Endurance</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6- and 12-min walk</td>
<td>• Distance</td>
<td>• Volitional fatigue</td>
<td>• Aerobic training may improve walking velocity.</td>
</tr>
<tr>
<td><strong>Strength</strong></td>
<td></td>
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</tr>
<tr>
<td>Weight machines</td>
<td>• Maximal voluntary contraction</td>
<td>• Use with electromyography to determine strength deficits.</td>
<td></td>
</tr>
<tr>
<td><strong>Flexibility</strong></td>
<td></td>
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</tr>
<tr>
<td>Goniometry</td>
<td>• Joint angles at full extension/flexion</td>
<td>• Especially important to measure ROM of neck, trunk, shoulders, hip, and knees.</td>
<td></td>
</tr>
<tr>
<td><strong>Neuromuscular</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gait and balance analyses</td>
<td>• Pull test, 360° turn, functional turn</td>
<td>• Level of difficulty</td>
<td>• Use gait analysis if functional gait training and/or motor control intervention is necessary.</td>
</tr>
<tr>
<td>Reaction time</td>
<td>• Timed walk, velocity, cadence, step length</td>
<td></td>
<td>• Classify disability level and define existing balance deficits.</td>
</tr>
<tr>
<td>Balance</td>
<td></td>
<td></td>
<td>• Reaction time is important to determine whether driving competence is questionable.</td>
</tr>
<tr>
<td>Gait</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Functional</strong></td>
<td>• Time</td>
<td></td>
<td>• Multiple attempts in the sit and stand may suggest quadriceps weakness and/or poor motor control. Weight training should specifically target quadriceps.</td>
</tr>
</tbody>
</table>

*Measurements of particular significance; do not always indicate test termination.
Exercise Programming

• Overall individualized program as the goal
• Include the following areas:
  – Flexibility
  – Aerobic conditioning
  – Strengthening
  – Functional training and motor control
Post-Polio
Postpolio Syndrome (PPS)

- Poliomyelitis (polio)- an acute viral disease, affects the lower motor neurons and causes muscle paresis, paralysis, and sometimes death.
- Vaccines have virtually eliminated acute paralytic poliomyelitis
- Approximately 16-40% of Polio survivors experience a relapse of symptoms 15 - 40 years after the original onset (Postpolio)
Types of Postpolio Syndrome

- Postpolio progressive muscular atrophy (PMMA)
  - Equated to neurological symptoms (loss of residual motor units)
  - Regarded as PPS
  - More intense in the legs, back, and arms
  - Increased stress on progressively weakening and wasting muscles intensifies joint instability
  - Worse when original paralysis affected all 4 limbs, ventilator was required, or age of onset after 10.
Types of Postpolio Syndrome

• Musculoskeletal postpoliomyelitis symptoms (MPPS)
  – Secondary “wear and tear”
Postpolio categories

- I (no clinical Polio)
- II (subclinical polio)
- III (clinically stable polio)
- IV (clinically unstable polio)
- V (severely atrophic)

Consult client’s neurologist and network with a team of rehabilitative specialist (PT, OT, Speech Therapist)
Pharmacology

- Nonsteroidal anti-inflammatory drugs (NSAIDs)
- Muscle relaxants
- Tricyclic antidepressants
  - increase HR and decrease BP during rest and exercise
  - ECG abnormalities
- Serotonin blockers
- Prednisone, amantadine, pyridostigmine, and bromocriptine mesylate
Secondary Conditions

- Fatigue
- Weakness
- Difficulty with concentration, memory, and attention span
- MPPS-musculoskeletal
  - Genu valgum
  - Genu recurvatum
  - Foot-drop
Genu valgum, Genu recurvatum, Foot-drop
<table>
<thead>
<tr>
<th>Methods</th>
<th>Measures</th>
<th>Endpoints*</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Aerobic</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Schwinn Air-Dyne™ (or any upper/lower limb ergometer) | • VO <sub>2</sub> peak, physical work capacity  
• 12-lead ECG, HR  
• BP  
• RPE (6-20)  
• METs | • Serious dysrhythmias  
• >2 mm ST-segment depression or elevation  
• Ischemic threshold  
• T-wave inversion with significant ST change  
• SBP > 250 mmHg or DBP > 115 mmHg  
• Volitional fatigue | • Use only if diagnosed CAD or related symptoms are present.  
• Calculate efficiency index.  
• Estimates functional capacity and predicts type or amount of ADLs and occupational tasks possible. |
| Arm ergometer                                    |                                                |                                                 |                                                        |
| **Endurance** |                                              |                                                 |                                                        |
| 6- and 12-min walk | • Distance                                   | • Note time, distance, symptoms at rest stops | • Can be adopted as a fitness indicator.  
• 1-mi (1.6K) walk may be too long in some cases. |
| 1-mi (1.6K) walk        | • Time                                       |                                                 |                                                        |
| **Strength** |                                              |                                                 |                                                        |
| Weight machines | • Submaximal endurance of stable and unstable limbs  
• Maximal voluntary contraction | • Fatigue                                       | • Dynamometer: hip and knee flexion/extension and ankle dorsi- and plantar flexion should be measured; no more than a 6-s effort at 45° angle.  
• Monitor and document changes caused by intervention or neuromuscular changes. |
| Dynamometers                         |                                                |                                                 |                                                        |
| **Flexibility** |                                              |                                                 |                                                        |
| Sit and reach | • Distance                                   | • Full ROM                                     | • Sit-and-reach measures middle and lower back flexibility, which is important for static and dynamic balance.  
• Goniometry measures specific joint active and passive ranges. |
<p>| Goniometry | • Angle at full flexion/extension            | • Full ROM                                     |                                                        |</p>
<table>
<thead>
<tr>
<th>Methods</th>
<th>Measures</th>
<th>Endpoints*</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Neuromuscular</strong></td>
<td></td>
<td></td>
<td>• Gait and balance analyses are useful in determining static and dynamic balance and locomotion if ambulatory.</td>
</tr>
<tr>
<td>Gait and balance analyses</td>
<td></td>
<td></td>
<td>• Nerve conduction studies, along with EMG, are useful in diagnosis and prognosis of stable motor units and their available readiness.</td>
</tr>
<tr>
<td>EMG/Nerve conduction studies</td>
<td>• Conduction velocities</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Action potential wave forms</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Functional</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sit to stand</td>
<td>• Balance and symmetry</td>
<td>• 10 reps completed; extensive use of arms; fatigue</td>
<td>• Use for ADLs and occupational tasks.</td>
</tr>
<tr>
<td>Lifting</td>
<td>• Balance, symmetry, and safety in techniques</td>
<td>• Potentially poor technique; fatigue</td>
<td></td>
</tr>
</tbody>
</table>

*Measurement of particular significance; do not always indicate test termination.

<table>
<thead>
<tr>
<th>Medications</th>
<th>Special Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Tricyclic antidepressants: Can affect motivation.</td>
<td>• Weakness and pain may be present in the lower limbs of patients with braces or orthotic appliances.</td>
</tr>
<tr>
<td>• Antidepressants (e.g., Elavil, Pamelor, Sinequan, Prozac, Zoloft): Inhibit neurotransmitters (i.e., serotonin, norepinephrine).</td>
<td>• Full or partial loss of sensation as well as fasciculations and paresthesia may be present in lower limbs.</td>
</tr>
<tr>
<td></td>
<td>• A 4-limb ergometer (e.g., Schwinn Air-Dyne™) with foot straps and/or pegs to rest inactive or nonfunctional limbs should be used.</td>
</tr>
<tr>
<td></td>
<td>• Consider use of discontinuous protocols in readily fatigued individuals.</td>
</tr>
</tbody>
</table>
Resistance Training Guidelines for Specific Disabilities - Post-Polio Syndrome

• Occurs several decades after the onset of polio.
• Approximately 25% of individuals will experience post-polio syndrome.
• Common Secondary Conditions:
  – Fatigue
  – Decreased endurance
  – New joint and muscle pain
  – Progressive weakness in muscles affected by polio and new muscle weakness
  – Respiratory insufficiency which may require ventilatory support (flying may be difficult).
  – Cold intolerance that contributes to muscle weakness.
Resistance Training Guidelines for Specific Disabilities - Post-Polio Syndrome

- Extremely important to communicate with the client’s physician.
- High intensity exercise is not recommended under any circumstances.
- Keep muscle fatigue to a minimum by starting and progressing VERY SLOWLY.
- Any new signs of pain or fatigue must be brought to the attention of the client’s physician.
## Polio and Post-Polio Syndrome: Exercise Programming

<table>
<thead>
<tr>
<th>Modes</th>
<th>Goals</th>
<th>Intensity/Frequency/Duration</th>
<th>Time to Goal</th>
</tr>
</thead>
</table>
| Aerobic | • Increase cardiovascular condition  
• Increase endurance of stable and maintain unstable limbs  
• Increase efficiency of ADLs and ambulation | • 40-70% VO₂peak or maximal HR reserve  
• 3 days/wk  
• 20-30 min/session (intervals initially for sedentary clients) | • Indeterminant  
• Increase, if tolerated, to 40 min continuous |
| Strength | • Isotonic exercises (restrictive devices)  
• Isometric exercises | • Increase strength of stable and maintain unstable limbs  
• Increase efficiency of ADLs and ambulation | • 3 sets of 10-15 reps  
• 2-3 contractions at 67% of 1RM every 20° of ROM of stable musculature/joints  
• 3 days/wk |
| Flexibility | • Stretching (passive) | • Increase ROM (if deficient)  
• Prevent contractures | • Perform with both stable (unless painful) and unstable (mild intensity) musculature/joints  
• 5-7 days/wk |

### Medications

- See exercise testing table

### Special Considerations

- Spasms and fasciculations (involuntary twitching of muscle fibers) indicate a need to decrease work period and increase recovery period.
- Progressive sudden fatigue indicates overly high intensity.
- Clients may lack motivation and/or compliance secondary to clinical depression.
- Rest periods during the day may be necessary during the initial stages of the exercise program.
- Reevaluation recommended every 3-6 mo.
Case Study-Post-polio
Spinal Cord Injury
Epidemiology of Spinal Cord Injury

- Approximately 250,000-400,000 people are affected by spinal cord injury in the U.S.
- Nearly 10,000 new cases occur each year.
- 80% involve young males ranging in age from 16 to 30.
- 85% of persons with SCI who survive the first 24 hrs. are still alive 10 years later.
- 53% Quadriplegia, 47% paraplegia.

(National Spinal Cord Injury Association)
Configuration of Spinal Cord

- There are 31 pairs of spinal nerves.

**Key Nerve Innervation Sites:**
- Cervical Nerves – C 4 -- head, neck, diaphragm,
- C5 -- elbow flexors, C6 – wrist extensors, C7 – triceps, C8 to T1 – hands.
- Thoracic – Chest and abdominal muscles.
- T1-2 – hands, T4-T7 – Chest, T8-T12 – Abdominals.
- Lumbar – Leg muscles.
- Sacral – Bowel, bladder, sexual function and feet.
ASIA IMPAIRMENT SCALE

- **A = Complete**: No motor or sensory function is preserved in the sacral segments S4-S5.
- **B = Incomplete**: Sensory but not motor function is preserved below the neurological level and includes the sacral segments S4-S5.
- **C = Incomplete**: Motor function is preserved below the neurological level, and more than half of key muscles below the neurological level have a muscle grade less than 3.
- **D = Incomplete**: Motor function is preserved below the neurological level, and at least half of key muscles below the neurological level have a muscle grade of 3 or more.
- **E = Normal**: Motor and sensory function are normal.

CLINICAL SYNDROMES

- Central Cord
- Brown-Séquard
- Anterior Cord
- Conus Medullaris
- Cauda Equina

NCPAD National Center on Physical Activity and Disability

www.ncpad.org ~ ncpad@uic.edu ~ 1-800-900-8086
The symptoms of spinal cord injury depend on the location of the injury and how severe the injury is. A complete spinal cord injury means that the spinal cord has absolutely no function below the affected area.
A partial spinal cord injury means that the spinal cord has some function left below the affected area.
A complete injury in the thoracic area of the spine causes complete paralysis in the legs, but the arms can still function. This is known as *paraplegia*. 
A complete spinal cord injury occurring between C1 and C3 leaves the patient unable to breathe on his or her own and unable to move the arms or legs. A patient with a C1 injury needs a respirator in order to breathe and cannot move the arms or legs.
## Functional Goals following SCI - Basic

### SCI - Functional Goals for Specific Levels of Complete Injury

<table>
<thead>
<tr>
<th>Level</th>
<th>Abilities</th>
<th>Functional Goals</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1-C3</td>
<td>C3-limited movement of head and neck</td>
<td><strong>Breathing:</strong> Depends on a ventilator for breathing.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Communication:</strong> Talking is sometimes difficult, very limited or impossible. If ability to talk is limited, communication can be accomplished independently with a mouth stick and assistive technologies like a computer for speech or typing. Effective verbal communication allows the individual with SCI to direct caregivers in the person's daily activities, like bathing, dressing, personal hygiene, transferring as well as bladder and bowel management.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Daily tasks:</strong> Assistive technology allows for independence in tasks such as turning pages, using a telephone and operating lights and appliances.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Mobility:</strong> Can operate an electric wheelchair by using a head control, mouth stick, or chin control. A power tilt wheelchair also for independent pressure relief.</td>
</tr>
<tr>
<td>C3-C4</td>
<td>Usually has head and neck control. Individuals at C4 level may shrug their shoulders</td>
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<tr>
<td>-------</td>
<td>------------------------------------------------------------------</td>
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</tr>
<tr>
<td></td>
<td><strong>Breathing:</strong> May initially require a ventilator for breathing, usually adjust to breathing full-time without ventilatory assistance.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Communication:</strong> Normal.</td>
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<tr>
<td></td>
<td><strong>Daily tasks:</strong> With specialized equipment, some may have limited independence in feeding and independently operate an adjustable bed with an adapted controller.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>C5</th>
<th>Typically has head and neck control, can shrug shoulder and has shoulder control. Can bend his/her elbows and turn palm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Daily tasks:</strong> Independence with eating, drinking, face washing, brushing of teeth, face shaving and hair care after assistance in setting up specialized equipment.</td>
</tr>
<tr>
<td></td>
<td><strong>Health care:</strong> Can manage their own health care by doing self-assist coughs and pressure reliefs by leaning forward or side-to-side.</td>
</tr>
<tr>
<td></td>
<td><strong>Mobility:</strong> May have strength to push a manual wheelchair for short distances over smooth surfaces. A power wheelchair with hand controls is typically used for daily activities. Driving may be possible after being evaluated by a qualified professional to determine special equipment needs.</td>
</tr>
</tbody>
</table>
| **C6** | **Daily tasks:** With help of some specialized equipment, can perform with greater ease and independence, daily tasks of feeding, bathing, grooming, personal hygiene and dressing. May independently perform light housekeeping duties.  
**Health care:** Can independently do pressure relief, skin checks and turn in bed.  
**Mobility:** Some individuals can independently do transfers but often require a sliding board. Can use a manual wheelchair for daily activities but may use power wheelchair for greater ease of independence. |
|---|---|
| **C7** | **Daily tasks:** Able to perform household duties. Need fewer adaptive aids in independent living.  
**Health care:** Able to do wheelchair pushups for pressure relief.  
**Mobility:** Daily use of manual wheelchair. Can transfer with greater ease. |
| Has movement in head, neck, shoulders, arms and wrists. Can shrug shoulders, bend elbows, turn palms up and down and extend wrists. | Has similar movement as an individual with C6, with added ability to straighten his/her elbows. |
| C8-T1   | Has added strength and precision of fingers that result in limited or natural hand function. | Daily tasks: Can live independently without assistive devices in feeding, bathing, grooming, oral and facial hygiene, dressing, bladder management and bowel management.  
|---------|-------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|
| T2-T6   | Has normal motor function in head, neck, shoulders, arms, hands and fingers. Has increased use of rib and chest muscles, or trunk control | Daily tasks: Should be totally independent with all activities.  
Mobility: A few individuals are capable of limited walking with extensive bracing. This requires extremely high energy and puts stress on the upper body, offering no functional advantage. Can lead to damage of upper joints. |
| T7-T12  | Has added motor function from increased abdominal control.                                       | Daily tasks: Able to perform unsupported seated activities.  
Mobility: Same as above. |
| L1-L5   | Has additional return of motor movement in hips and knees.                                       | Health care: Has improved cough effectiveness.  
Mobility: Walking can be a viable function, with the help of specialized leg and ankle braces. Lower levels walk with greater ease with the help of assistive devices. |
| S1-S5   | Depending on level of injury, there are various degrees of return of voluntary bladder, bowel and sexual functions. | Mobility: Increased ability to walk with fewer or no supportive devices. |
Quadriplegia (Tetraplegia)

- Damage to any of the 8 cervical nerves. All four limbs and trunk are involved.
- Diaphragm is affected in high lesions – 4th cervical and higher.
- In general, the higher the lesion the greater the risk of morbidity and mortality.
- Most will require a power chair.
Paraplegia

• Damage to thoracic, lumbar, or first and second sacral nerves.
• Can independently ambulate in a wheelchair.
Common Cardiovascular Events Observed in Persons with SCI

• Orthostatic hypotension
• Autonomic dysreflexia (above T6 – sudden blood pressure response)
• Loss of reflex cardiac acceleration
• Quadriplegic cardiac atrophy: loss of ventricular mass
Spina Bifida

• Definition:
  – Defect of the spinal column caused by failure of one or more vertebral arches to close before birth.
  – The defect takes the form of a sac caused by protrusion of the spinal cord and CSF fluid through the opening.
  – Thought to occur within the first trimester of pregnancy. However, primary cause is unknown.
Spina Bifida

- **Three types:**
  - **Spina bifida occulta**
    - Most common and least severe type.
    - Spinal cord and nerves are typically not damaged.
    - Neurological functioning is intact.
  - **Meningocele**
    - Least common.
    - Meninges are pushed through the opening in the vertebrae and form a sac (herniation).
    - Sac contains meninges and CSF.
    - Spinal cord remains intact.
    - Corrective surgery is performed to remove the sac.
    - Rarely associated with neurological disabilities.
Spina Bifida

- **Myelomeningocele**
  - Most severe type.
  - Vertebrae fails to fuse and the meninges and spinal cord protrude to form a sac.
  - Protruding sac contains the meninges, portions of the spinal cord, and nerve roots.
  - Most frequent site of damage is the lumbosacral region.
Associated Conditions

• Hydrocephalus
  – Requires a shunt
  • Ventriculoperitoneal
  • Ventriculoatrial
Associated conditions

- **Chiari (kee-ar-ee) Malformation**
  - Major cause of death and disability among persons with SB.
  - Are congenital abnormalities of the posterior fossa (base of brain where the spinal column joins the skull). This usually causes a protrusion of the cerebellum through the bottom of the skull (foramen magnum) into the spinal canal. This results in a poor circulation of cerebrospinal fluid from the brain to the spinal cord.
Associated Condition in Spina Bifida

- Scoliosis
- 80% have average intelligence, yet often have specific learning disabilities.
- Tethered Spinal cord
Secondary Conditions Associated with Spina Bifida

- Obesity
- Osteoporosis
- Urinary Tract Infections
- Depression
- Pressure ulcers
- Latex allergies common
Aging with a SCI

- **Secondary Conditions** include: carpal tunnel syndrome, COPD, myocardial infarction, diabetes, kidney stones, pressure ulcers, osteoporosis, and hypertension.

- **Major chronic secondary condition**: overuse injuries from pushing wheelchair.
Exercise in Persons with SCI

• Although SCI per se may not predispose persons to CHD, their “extraordinarily low levels of physical activity” place them at the lowest end of an “epidemiological spectrum,” both in terms of physical activity and health risk.

• Peak VO$_2$ levels of young persons with SCI are generally in the 20s and low 30s.
  – Blair’s research indicated that a peak VO$_2$ $\leq$ 6 METs ($\leq$ 21 ml.kg.min) significantly increases the risk of morbidity and mortality from all causes.
Exercise in Persons with SCI

- Athletes with SCI have higher levels of fitness than nonathletes with SCI.
- Athletes with SCI have lower levels of fitness than nondisabled persons.
- Persons with paraplegia have higher fitness levels than persons with quadriplegia.
- Cardiac function and fitness can be improved with exercise.
Secondary Conditions Associated with SCI

Incontinence
Loss of bladder and bowel function. Occurs in lesions above S2. Alleviated by catheterization or urinary bag.

Exercise Guidelines:
Make sure bladder is voided before exercise. Know where urinary bag is located and void before exercise.
Spasticity

• Where: Occurs in the muscles below the site of injury.
• Signs: Increased muscle tone and hyperactive stretch reflexes.
• Result: can lead to contractures and can be painful.
Exercise Testing for SCI

- Arm crank ergometer (ACE) or wheelchair ergometer (WERG)
- Maximum HR will be 10-20 bpm lower than for strenuous leg exercise (in persons with T6 and higher – MHR will be limited)
- If ACE is not available, use a wheel test (however, this is not very accurate).
- Peak HR will range from 110-130 for persons with tetraplegia
- Variations in HR for persons with T1-T6 injury.
- Regular MHR can be attained in persons with T7 and below.
Exercise Guidelines

• Stretch spastic muscle groups (but don’t overstretch).
• Avoid exercises that cause excessive spasticity.
• Provide home remedies to avoid contractures (e.g., keep legs extended as often as possible).
• Make sure antispasmodic or muscle relaxant drug has been taken (most common types: diazepam, baclofen, dantrolene sodium).
• Know side effects of medication.
Autonomic Dysreflexia

- A noxious stimulus results in an excitation of the sympathetic nervous fibers leading to a profound vasoconstriction in the visceral arteries of the splanchnic bed resulting in a sudden increase in blood pressure.
- Occurs in 60-80% of persons with a SCI at T6 or higher.

Exercise Guidelines:
- Make sure bladder has been voided before exercise.
- Check on last bowel movement which could also cause it.
- Check blood pressure periodically.
- Make sure there has not been skin trauma during transfers.
Orthostatic Hypotension

- Drop in SBP > 20 mmHg
- Drop in DBP > 10 mmHg
- Cause: Blood pools in the lower extremities and abdominal region.
- Paralyzed muscles are unable to pump blood back to the heart, which results in a decreased blood flow to the brain.
- Can cause nausea, dizziness, syncope.
Exercise Guidelines for Orthostatic Hypotension

• Be cautious when assisting clients up from a mat or bench press machine, etc.
• Give the client a few seconds to regain equilibrium.
• Avoid quick movements.
• If it does occur:
  – Place supine with feet elevated.
  – Record date, time and type of activity
Exercise Guidelines for Orthostatic Hypotension

- Provide orthostatic training (e.g., standing exercise using a tilt table), but watch for exercise hypotension (blood pooling in lower extremities).
- Maintain proper hydration.
- Use compression stockings and an abdominal binder.
Thermoregulation

• SCI (and MS) often result in impaired thermoregulation.
• External temperature must be carefully monitored to avoid hyper- or hypothermia.

Guidelines for Exercise
• Monitor body temperature particularly in high level athletes.
• Control body temperature using fans, water, etc., particularly in warm gyms.
• Wear appropriate clothing.
Pressure Ulcers

• Also referred to as pressure sores (old term: decubitus ulcers).

• Major causes:
  – Prolonged sitting.
  – Use of old, deteriorated wheelchair cushions.
  – Sitting on hard surfaces.
  – Falls while transferring.
  – Excessive sweating or lack of attention to a reddened area.
Pressure Ulcers

- Damage to skin and underlying tissues resulting from unrelieved pressure.
- 1:3 individuals with SCI develop a pressure ulcer each year.
- Common sites: sacrum, ischium, greater trochanters, and heels.

Guidelines for Exercise Physiologist:
- Avoid them.
- Check client’s skin regularly.
- Minimize pressure on weight-bearing tissues using cushions.
- Perform wheelchair pushups – Frequency: 30-60 sec. Every 10-30 min.
Resistance Training Guidelines for SCI

• Upper body strength is crucial to successful independent living.
  – Transfers
  – IADL (pulling self into car)
  – ADL (e.g., dressing – lifting one side of body to get pants leg on)
  – Pushing up a ramp or curb cut.
• Keep a lookout for pressure ulcers (wheelchair push-ups – every 15 to 20 minutes).
Exercise Considerations for Wheelchair Users
Wheelchair Design

• Standard wheelchair is often referred to as hospital chair – heavy and awkward but very durable.

• Newer chairs are often referred to as sports chairs (I.e., Quickie).

• Detachable parts: handles, footplates, antitip wheels, wheels.
Variations in Wheelchairs

• Motorized wheelchair is a battery-operated chair. It is very heavy.
• Motorized wheelchair can be controlled by hand or mouth (sip and puff device).
• Sports wheelchairs are made of lightweight material similar to expensive bikes.
• Sports wheelchairs have lower backs and may not have push handles, armrests, or brakes.
• Frames are often rigid and do not fold (backrest folds over seat).
• Many wheelchair users now prefer a sports chair for everyday ambulation (sleeker look).
Wheelchair Guidelines

• Stability –
  – make sure brakes are in good working order.
  – Lock wheels during activity or transfers.
  – Use chest strap or waist belt for high level injuries.
  – Use a flexible band across legs if excessive spasticity interferes with the exercise routine.
• Postural alignment
  – Persons who use wheelchairs often have poor alignment.
  – Extremely important for preventing back discomfort or pain.
  – Develop good sitting posture by strengthening appropriate musculature (e.g., neck extensors, shoulder retractors, abdominal musculature if still functional).
  – Make sure feet are not dangling if footrests are removed.
Wheelchair Guidelines

• Transfers
  – One person transfers are not recommended unless there is no help available.
  – Two person transfers are always safer for both the client and staff.
General Safety Guidelines for Working with Wheelchair Users

1. Reduce distance between the transfer surface and the wheelchair.
2. Always secure brakes.
3. Provide surfaces of equal height if possible.
4. Maintain a wide base of support and use legs not back to lift person.
5. Make sure the person knows when you are ready to perform the transfer.
General Safety Guidelines for Working with Wheelchair Users

• Pushing a client in a wheelchair:
  • Make sure the person is ready to move.
  • Always ask before you move any assistive device.
• Never tip a wheelchair forward to get over a curb – always tip backward lifting casters off the ground.
• Make sure brakes are in good working order.
• Make sure casters are well lubricated.
Wheelchair (Disability) Terminology

• **Wheelchair user** is the correct phrase.
  – **NEVER** use the following terms:
    Wheelchair bound
    Wheelchair confined
    Wheelchair dependent

• **Person First** terminology
  – “The new client has paraplegia, quadriplegia, post-polio, cerebral palsy.”
  – One negative term can hurt a staff/client relationship!
Exercise Program for Individuals with Spinal Cord Injuries: Paraplegia
Main Menu

Precautions
(first time users click here)

How Hard Should I Exercise?

Aerobics

Strength & Flexibility

Credits

Subtitles
Aerobics
Flexibility
Cool Down
Case Study-SCI
Resistance Training
Resistance Training for Persons with Disabilities

- In some respects, it is more important than in the general population.
- Lack of strength can severely compromise the quality of life.
Morey and coworkers – *MSSE*, 1998
Examined the relationship between physical fitness and physical independence (M age = 72.5 yr).

**Results**: Strength, cardiorespiratory endurance and flexibility significantly improved physical function.
Resistance Training Guidelines for Persons with Long-Term Disabilities

- Persons with physical disabilities are often confronted with significant mobility limitations.
- They also have a number of associated and secondary health conditions.
- When combined with the natural aging process, the likelihood of losing physical independence increases substantially.
- High levels of fitness, particularly strength, are extremely important in both progressive and non-progressive disorders.
Importance of Resistance Exercise

• More strength developed early in life, greater reserve in later life.
• ADL and IADL are easier to perform.
• Many people with physical disabilities must switch to a manual or powered wheelchair when strength declines.
• Lack of strength may make it difficult to continue working in positions that require ambulation or standing.
General Resistance Training Guidelines – Understanding the Disability

• What are the associated and secondary conditions that underlie each impairment?
• Is the condition progressive or non-progressive?
• What muscle groups are still functional?
• Is there a noticeable weakness on one side of the body (hemiplegia)?
Asymmetrical Weakness - Hemiplegia

• Common in stroke and CP.
• Is there still nerve innervation on hemiplegic side?
• Develop a separate training regimen for the weakened side.
  – May require adaptive devices such as a glove or mitt to hold weight.
Resistance Guidelines for Spasticity

• Avoid increasing abnormal muscle tone.
• Reciprocal inhibition: Strengthen opposing muscle group to spastic muscle.
• Spastic muscle groups that are incapable of being strengthened should be stretched.
• Consult with a therapist to determine how far a muscle can be stretched.
• Coordinate with medications.
Resistance Training Guidelines

• Training volume:
  – Will vary in persons with similar and different impairments.
  – Will depend on amount of muscle mass that is still functional.
  – Progressive disorders (post-polio, MS, ALS) must start at very low levels and be carefully monitored.
  – The greater the level of disability the lower the training volume (rest interval, reps, sets).
Resistance Training Guidelines

**Intensity:**
- *Progressive* disorder – 30-50% 1-RM or 10-RM
- *Nonprogressive*: 70-80% 1-RM
- Will also depend on age and health status (e.g., hypertension, fatigue)

**Frequency:** 2-3 days/wk.

**Modality:** Whatever works
Resistance Training Guidelines

• Training Progression:
  – Will vary according to the age and health status.
  – Active-assistive exercise may be necessary in certain individuals and/or in certain muscle groups.
• Determine which muscle groups are still functional.

Classify by function:
  • Completely functional
  • Partially functional (paresis)
  • Non-functional (paralysis)

Example: Persons with CP have severe adductor spasticity (secondary condition) at hip joint. How functional are hip abductors?
Maintaining Good Notes

• Keep meticulous records on each client.
  – Understand secondary and associated conditions of each primary disability.
  
    – Example: What are the secondary and associated conditions with stroke?
    – Stroke – secondary conditions .....................
    – Associated Conditions ............................
Exercise Prescription Guidelines

- Use SOAP note and daily exercise prescription chart.
- S – subjective
- O – objective
- A – assessment
- P – prescription
Avoiding Soreness and Injury

• Preventing both soreness and injury is extremely critical to the success of your program.
• With progressive disorders such as multiple sclerosis, post-polio, muscular dystrophy and amyotrophic lateral sclerosis (ALS), even greater concern must be given.
• Hallmark sign: pain or soreness 24 to 48 hours after activity.
• Determine if pain is in the joint or muscle.
Common Injuries in Manual Wheelchair Users

- Injuries resulting from repetitive motions to small muscle groups:
  - Stress fractures
  - Rotator cuff tears
  - Lateral epicondylitis
  - Carpal tunnel syndrome

- Try not to exacerbate the condition.
- Remember that most clients may be quite sedentary before joining your program.
Monitoring Blood Pressure

• A must during the early stages of the program.

• Why?
  – Hypertension common in various groups.
  – SCI has a condition known as:
    • Autonomic dysreflexia
    ACSM Guidelines: What are they?
    • Systolic:
    • Diastolic:
Resistance Training Guidelines

• Special Program Adaptations
  – Gloves
  – Watch for “hiking” the body on weak side.
  – Avoid valsalva maneuver.
  – Straps for wheelchair users.
  – Evaluate static and dynamic balance.
  – Which machines are accessible/inaccessible?
Glove for Assisting Grip
Cardiovascular Exercise
General Aerobic Exercise Guidelines for People with Disabilities

Use Rating of Perceived Exertion (RPE) along with heart rate.

• Persons with high level SCI will only be able to achieve MHRs of approximately 120 bpm.
• 90-100 bpm may be an adequate THR for persons with tetraplegia.
• Most accurate method for establishing THR is from peak VO2 test.
<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Extremely Easy</td>
</tr>
<tr>
<td>7</td>
<td>Very, Very Light</td>
</tr>
<tr>
<td>8</td>
<td>Very Light</td>
</tr>
<tr>
<td>9</td>
<td>Fairly Light</td>
</tr>
<tr>
<td>10</td>
<td>Somewhat Hard</td>
</tr>
<tr>
<td>11</td>
<td>Hard</td>
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<tr>
<td>12</td>
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</tr>
<tr>
<td>13</td>
<td>Very Hard</td>
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<td>16</td>
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<tr>
<td>17</td>
<td>Very, Very Hard</td>
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<tr>
<td>18</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Extremely, Extremely Difficult</td>
</tr>
<tr>
<td>20</td>
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</tbody>
</table>
Aerobic Exercise Guidelines for Persons with Paralysis

• In persons with paraplegia, arm exercise will elicit HR’s 10-20 bpm lower than for leg exercise.

• Avoid Autonomic Dysreflexia by monitoring blood pressure.
Aerobic Exercise Guidelines for People with Disabilities

- Use SOAP notes to guide the exercise program.
- Exercise in 5 to 10-minute increments.
- Monitor fatigue and pain carefully (use various scales such as the Fatigue Severity Scale)
Sample Aerobic Activities for Wheelchair Users and Persons with Lower Extremity Impairments

- Nu-Step recumbent stepper
- Schwinn Air-Dyne (arms only)
- Upper arm ergometer
- Elliptical Cross-Trainer
- Interval wheeling
- Hybrid exercise (i.e., Thera-cycle)
- Functional Electrical Stimulation (FES)
Thermoregulatory Guidelines

• SCI and MS often result in impaired thermoregulation.
• External temperature must be carefully monitored to avoid hyper- or hypo-thermia.

Guidelines for Exercise:
• Monitor body temperature particularly in high level athletes.
• Control body temperature using fans, water, etc., especially in warm gyms.
• Wear appropriate clothing.
Common Overuse Injuries in Wheelchair Users

- Blisters, Abrasions, & Lacerations
- Carpal Tunnel Syndrome
- Rotator Cuff Strain/Shoulder Impingement
Reducing Injury in Wheelchair Users

• Use work out gloves with adequate padding.
• Push rims should be padded.
• The angle of push rims to the seat must be optimally positioned to provide the most comfortable and efficient push angle.
• Legs should be securely strapped.
• Helmets should be worn during wheeling activities.
• Good stretching routine before workout.
Reducing Injury in People with Disabilities

- Avoid overuse injuries by varying exercise routine (e.g., cross-training, various types of equipment) and using proper equipment.
- Vary exercise routines on alternate days.
- Monitor pain and fatigue levels closely.
- Assess balance before implementing standing activities (e.g., weight routine, aerobic dance class).
General Aerobic Exercise Guidelines and SCI

- Persons with high level SCI will only be able to achieve MHRs of approximately 120 bpm.
- 90-100 bpm may be an adequate THR for persons with tetraplegia.
- Most accurate method for establishing THR is from peak VO2 test.
- Use Rating of Perceived Exertion (RPE) along with heart rate.
Aerobic Exercise Guidelines for Persons with SCI

• In persons with paraplegia, arm exercise will elicit HR’s 10-20 bpm lower than for leg exercise.

• Avoid Autonomic Dysreflexia by monitoring blood pressure.
• Difficult to provide “blanket” exercise recommendations for all secondary conditions since they interact with other factors – associated conditions, environment.

• Should adapt physical activity prescriptions based on specific impairments, activity limitations, participation restrictions (ICF).
Aerobic Exercise Guidelines for People who are Severely Deconditioned

• Use SOAP notes to guide the exercise program.
• May have to exercise in 5 to 10-minute increments.
• Monitor fatigue and pain carefully (use various scales such as the Fatigue Severity Scale)
Reducing Injury in People with Disabilities

- Avoid overuse injuries by varying exercise routine (e.g., cross-training, various types of equipment) and using proper equipment.
- Vary exercise routines on alternate days (i.e., cross-training).
- Monitor pain and fatigue levels closely.
- Assess balance before implementing standing activities (e.g., weight routine, aerobic dance class).
Pain-Related Issues

Pain in certain movements or joints:
- Is it pain or soreness?
- Is it tolerable or intolerable?
- Does it worsen over time or go away after the exercise?
- Is there stiffness 24 to 48 hours later?
- Is the pain isolated to a certain part of the body?
- What does the pain feel like?
- Develop a 1-10 pain/discomfort index.
Helpful Resources

- [www.ncpad.org](http://www.ncpad.org) 1-800-900-8086