

Exercise and the Polio Survivor

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We're Still here! Living with the Late

Effects of Polio Conference

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Dangers of Exercise

- Use it and Lose it
- “Muscle strengthening exercise adds to overuse. Pumping iron and “feeling the burn” mean that polio-damaged neurons are burning out. Polio survivors typically can’t do strenuous exercise to condition their hearts.”

Dangers of Inactivity

- Deconditioning can result from limited activity as well as immobility
- Muscle atrophy most pronounced in anti-gravity or postural muscles, lower limbs more than upper limbs
- During strict bed rest, muscles lose 10% to 15% of their original strength per week and 35%-50% over 5 weeks
- Connective tissue contractures
- Osteopenia

Health Benefits of Exercise

- Cardiovascular disease: inactivity is a major risk factor for development of disease
- Secondary prevention: reduced mortality with cardiac rehabilitation
- Decreased blood pressure
- Lowered triglycerides, increased HDL “good” cholesterol
- Reduced risk of blood clots

Health Benefits of Exercise (continued)

- Inverse relationship between obesity and activity
- Diabetes reduced progression from glucose intolerance to diabetes; increased insulin sensitivity
- Maintenance of bone density
- Improved sleep quality
- Improved quality of life and sense of well-being

How Much Exercise?

- Individual need: risks and benefits
- Medical evaluation
- Goal: 30 minutes/day
- Activity vs. Exercise
- Benefits are dose-related
- Long term compliance
- Lifestyle balance

Exercise Components

- Aerobic Conditioning
- Strengthening
- Flexibility
- Coordination

Aerobic Conditioning

- Low intensity, long/duration activity
- Increased energy, demand can be met by aerobic metabolism
- Oxygen is required for metabolism of carbohydrates and fat
- Rate of energy production slow, but total production virtually unlimited
- No fatiguing or painful by-products produced

Oxygen Uptake

- Oxygen uptake (V_{O_2}) measures rate of oxygen utilization for production of energy
- Measured as liters/min or liters/kilogram/minute
- Metabolic equivalent (MET) equals 3.5 mL/kg/min which is approximately resting state
- V_{O_2} max is a measure of work capacity and cardiorespiratory fitness

Physiological Adaptations to Aerobic Exercise

- Heart
 - Increased cardiac output
 - Increased Stroke volume
 - Increased blood volume
- Muscle
 - Increased oxygen extraction in muscle
 - Increased capillary density
 - Increased capillary muscle fiber ratio
 - Increased number and size of mitochondria per muscle cell

Physiologic Changes due to Aerobic Exercise

- Heart Rate
- Stroke Volume
- Cardiac Output
- Myocardial O₂ demand
- Ventilation
- Arteriovenous O₂ difference
- Blood lactate concentration
- Muscle Blood flow
- Blood Pressure

Results of Aerobic Conditioning

- Ability to do more activity
- Increased MET tolerance
- Energy Efficiency Improved
- Everyday tasks are easier to do
- Most polio survivors need some aerobic conditioning

ET Equivalents 1.5-2

Seated ADLs (Eating, Hygiene) Seated Recreation/Work

METS 2-3

(Writing, Typing)

Standing ADLs (Showering, Dressing) Slow Walking, Standing

METS 4-5

Recreation

Heavy Housework, Brisk Walking, Golfing, Canoeing,

METS 6-7

Badminton

Heavy Gardening, Climbing Stairs, Speed Walking

METS 8-9

Heavy Labor, Jogging 5-6 mph

Basics of Aerobic Conditioning

- Submaximal intensity
- Repetitive activity
- Exercise mode should incorporate a large muscle mass
- Perceived Exertion of “fairly light” to “hart”
- Duration of at least 20 minutes
- Exercise frequency at least 3 times/week

Additional Guidelines for Polio Survivors

- Strongest muscle groups should be used for repetitive aerobic exercise
- Exercise should not increase stress on weak muscles or overstressed or unstable joints
- Consider non-weight bearing mode of exercise
- May need to start well below suggested intensity, time and frequency to keep exercise at sub-maximal level
- Use of rest intervals may be essential
- Always monitor for overuse

Strengthening Exercise

- Muscles, ligaments, tendons, connective tissue and bones respond to physiologic stress or near maximum loads
- Structural changes occur that increase the strength of the tissues
- Exercise must stress tissues without over-stressing
- Overwork may result in injury

Adaptations to Strengthening Exercise

- Adaptations occur in both muscle and central nervous system
- Increased number of motor units activated
- Increased rate of activation
- Improved synchronization of motor units
- Increased size of muscle fibers by increased protein and number of myofibrils

Adaptations to Strength Training

- Increased number of capillaries
- Increased thickness and strength of ligaments and connective tissue
- Increased bone density
- Increased cartilage thickness

Basics of Strengthening Exercise

- Progressive Resistance Exercise
- Exercises done in sets of repetitions with rest period between sets
- Intensity determined by maximum strength
- Volume of exercise gradually increased
- Program must be individualized
- Response can vary based on genetics, number of muscle fibers
- Use of personal trainer can lead to more optimal gains

Considerations for Strengthening Programs

- Which muscles need to be trained?

- Functionally Important
- What type of muscle action (isometric, eccentric)?
- Isokinetic: strengthening through range of motion
- Isometric: strengthening without movement
- Eccentric: strengthening while muscle lengthening
- Prior injuries, weak areas, at risk areas?

Components of Strength Training

- Number of sets
- Initially single-set can be effective
- Long-term multiple-sets are more productive
- Rest period between sets
- Intensity or amount of resistance
- Based on desired number of reps
- Lower reps increase strength
- More reps increase endurance

Components of Strength Training

- Repetition Speed
- Higher speed improves power
- Rest Periods between workouts
- Heavy loads and eccentric training require longer rest periods
- Progression of frequency
- Split programs

Guidelines for Polio Survivors

- Set specific goals for functional gains
- Don't strengthen just because a muscle is weak
- Be aware of at-risk muscles and at-risk joints
- If body mechanics or joint positions are altered use isometric strengthening
- Polio affected muscles will require longer rest periods to recover between sessions

Flexibility

- Pliability or elasticity of muscles, connective tissue, tendons and ligaments
- Ideal Range of flexibility maximizes muscles function

Flexibility / Stretching Exercises

- Restoration and maintenance of functional range of motion
- Identify any restrictions of motion that impact function and stress other tissues
- If connective tissue is not stretched, it will gradually shorten
- Genetics, gender, age, temperature affect flexibility
- Excess motion is not beneficial

Stretching Exercise

- Ballistic stretching – repetitious bouncing
 - Greatest risk of injury
- Static stretching – slowly applied and held for several seconds
 - 15-20 seconds 4 repetitions
- PNF stretching
- Contract – relax or agonist contract – relax

Guidelines for Polio survivors

- No fear of muscle “overuse”
- Static stretching safest method

- Heat before stretching
- Muscles imbalance around a joint will lead to loss of motion if not stretched
- Bony changes/fusions may also contribute to loss of motion 0- never force stretch
- Do not stretch an over-lax joint

Coordination and Balance

- Improved proprioception – awareness of position and movement of body parts
- May be affected by arthritis, neuropathy, age, range of motion
- Balance exercises
- Strengthening postural muscles
- Proprioceptive feedback with external stimulus

Exercise Guidelines Based on Polio Involvement of Muscles

- Individual muscles and limbs have different exercise needs and tolerance
- Careful assessment important to design appropriate exercise program
- Developed by the National Rehabilitation Hospital based on available research on polio survivors

NRH Polio Muscle Classification

- Class I No clinical Polio
- Class II Subclinical Polio
- Class III Clinical Stable Polio
- Class IV Clinically Unstable Polio
- Class V Severely Atrophic Polio

Exercise Goals Based on NRH Classification

- Class I: No clinical Polio (Grade 4-5)
- Increase muscle strength
- Improve cardiovascular endurance: can use these muscles for aerobic exercise
- May exercise 3-4 times/week for 15-30 minutes at an HR of 60-80% max
- Stretching

Exercise Goals Based on NRH Classification

- Class II: Subclinical Polio
- No history of past or new weakness but with EMG evidence of polio involvement (Grade 4-5)
- Maintain normal strength
- May be used for aerobic conditioning
3-4 times/week for 10-20 minutes
- Paced activity with alternating rest intervals/days
- Monitor for signs of overuse

Exercise Goals Based on NRH Classification

- Class III Muscles: Clinically Stable Polio
- Remote history of weakness with no new weaknesses (grade 3-4)
- Maintain Strength and gain strength if deconditioned
- Active or passive range of motion
- Modified strengthening with pacing and careful monitoring
Non-weight bearing exercise preferred

Exercise Goals Based on NRH Classification

- Class IV Muscles: Clinically Unstable Polio
 - Developing new Weakness
 - Prevent/further weakness
 - Decrease activity, if overuse suspected
 - If disuse suspected, rest does not help:
 - Range of motion exercises
 - Non-fatiguing exercise, gravity eliminated
 - Careful monitoring
 - No more than 3 times/week

Exercise Goals Based on NRH Classification

- Class V Muscles: Severely Atrophic Polio (Grade 1-2)
 - Passive range of motion
 - Active range of motion in pool, monitoring for signs of overuse

Symptoms/Signs of Overuse

- Significant fatigue lasting more than 2-3 hours after activity
- Increased weakness after activity
- Painful Muscles
- Muscles twitching, cramping, “crawling”
- Symptoms may not present until 1-2 days after activity

Summary

- Exercise is not the enemy
- Exercise should not hurt, but it not “easy”
- Exercise programs must be individualized
- Medical Assessment before starting
- Know your body and learn its signals
- Exercise performed with a proper prescription, instruction and technique can lead to improved function and well-being.