Physical Therapy Considerations for Children with Down syndrome

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The Big Picture

The focus of physical therapy is develop a body that is fit and functional for a lifetime

- Reducing unhelpful compensations
- Encouraging Participation
- Possibly accelerating the rate of milestones
Settings for Physical therapy

- Neonatal Intensive Care Unit
- Early Intervention
- School-based
- Inpatient hospital or rehab hospital (acute care)
- Outpatient
- Wellness groups
- Specialty Clinics
When does my child need PT?

When they are working towards achieving a new gross motor skill or participating in a sport

When their gross motor limitations are impacting their safety or participation in school, recess or in gym class

After an orthopedic surgery

When musculoskeletal pain issues arise
Musculoskeletal Factors

Low Muscle Tone (hypotonia)- a low level of muscle contraction during a resting state; limited resistance to passive movement of a muscle

Affects all areas of the body, including oral motor skills and intestinal motility
Musculoskeletal Factors

- Ligamentous Laxity (Loose ligaments)
  - Decreased collagen fibers
- Decreased Strength
- Delayed skeletal maturation
  - Short arms and legs
Musculoskeletal Factors

Hypotonia

Strength

Ligamentous Laxity
Underlying Causes of Motor Difficulties

1. Cerebellum hypoplasia
   o muscle hypotonia
   o axial control of the trunk
   o body balance
   o coordination
   o speech disorders

2. Corpus Callosum size affect coordination

3. Other health concerns or illnesses
Associated Conditions that may affect mobility

- Obesity
- Hearing and vision loss
- Cardiac abnormalities
- Decreased mobility from surgery
- Seizures
- Sleep apnea
- Ear infections
- Chronic upper respiratory problems
Motor Learning Considerations

1. Reduce hands-on support when safe to avoid dependence

2. Practice new skills in new environments

3. Provide visual and tactile cues
Motivation Strategies

• Visual Schedules
  o Shows the order of activities during therapy
Motivation Strategies

• Token Charts
  o Child works for an object or activity by rewarding a desired behavior
Motivation Strategies

• “First __, Then __” Visual
  o Shows something the child prefers that they will get after completing a less preferred task
Movement Patterns

• Decreased kicking in infancy
• Wide-base of support with all activities
• Movement in straight planes
• Co-activation of muscles for stability
• Latent (delayed) muscular responses
• Require more time to learn movement as movement complexity increases (Palisano, 2001)
• Slowness of movement
• Less precise, coordinated & efficient
<table>
<thead>
<tr>
<th>Milestone</th>
<th>Kids with Down syndrome (Median)</th>
<th>Range with Down syndrome</th>
<th>Typically Developing (Median)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rolls to prone</td>
<td>7 months</td>
<td>5-9 months</td>
<td>7 months</td>
</tr>
<tr>
<td>Sits unsupported</td>
<td>10 months</td>
<td>8-11 months</td>
<td>7 months</td>
</tr>
<tr>
<td>Crawls</td>
<td>14 months</td>
<td>9-19 months</td>
<td>8 months</td>
</tr>
<tr>
<td>Pulls to Stand</td>
<td>15 months</td>
<td>8-26 months</td>
<td>8 months</td>
</tr>
<tr>
<td>Stands Alone</td>
<td>18 months</td>
<td>12-38 months</td>
<td>11 months</td>
</tr>
<tr>
<td>Walks Alone</td>
<td>23 months</td>
<td>13-48 months</td>
<td>12 months</td>
</tr>
<tr>
<td>Runs</td>
<td>4 years</td>
<td>NA</td>
<td>1 ½ years</td>
</tr>
<tr>
<td>Jumps</td>
<td>4-5 years</td>
<td>NA</td>
<td>2 years</td>
</tr>
</tbody>
</table>

Developed from Winters, 1997 and Pereira et al, 2013
Probability of Achieving Gross Motor Skills *Palisano et al, 2001*

Study of 121 children, showing percentage of children who reached these milestones by age in months

<table>
<thead>
<tr>
<th></th>
<th>6</th>
<th>12</th>
<th>18</th>
<th>24</th>
<th>30</th>
<th>3f6</th>
<th>48</th>
<th>60</th>
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<tbody>
<tr>
<td>Sit</td>
<td>8</td>
<td>78</td>
<td>99</td>
<td>100</td>
<td>100</td>
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<td>100</td>
<td>100</td>
<td>100</td>
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<tr>
<td>Crawl</td>
<td>10</td>
<td>19</td>
<td>34</td>
<td>53</td>
<td>71</td>
<td>84</td>
<td>96</td>
<td>99</td>
<td>100</td>
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<tr>
<td>Walk</td>
<td>1</td>
<td>4</td>
<td>14</td>
<td>40</td>
<td>74</td>
<td>92</td>
<td>99</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Run</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>5</td>
<td>8</td>
<td>12</td>
<td>25</td>
<td>45</td>
<td>67</td>
</tr>
<tr>
<td>Jump</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>5</td>
<td>18</td>
<td>52</td>
<td>84</td>
</tr>
</tbody>
</table>
Orthopedic Issues
Green, 2008

• Scoliosis (thoracogenic)
  o 8.7% (Milbrandt & Johnson, 2005) n=379

• Arthropathy similar to Arthritis
  o Polyarticular (in >1 joints) with subluxation, 1.2% (Olson, 1990)
Orthopedic Issues

- Hip issues
  - Hip dislocation/dysplasia, symptomatic 2-10 years with limp, poor gait, pain, 1.25-7%
  - Slipped Capital Femoral Epiphysis 1.3%, Perthes 2%
  - Progressive hip instability after skeletal maturity
Orthopedic Issues

• Patellofemoral (knee) Instability
  o 20% instability, 4-8% dislocation
• Pes planus (flat feet)
• Osteoporosis, lower Bone Mineral Density even at young age (Center, 1998) which can lead to fractures
Atlanto-Axial Instability

• 15-20% have subluxation, 1% is symptomatic
• Symptoms:
  o Neck pain/stiffness, cervical deformity, headache, extremity pain, deterioration of gait, spasticity, hemiparesis, hyperreflexia, bowel/bladder changes
• Could cause acute cord compression or sudden death
• X-Ray Screenings?
  o AAP no longer recommends
  o Special Olympics requires

• Separhi et al, 2005 and Bull 2013
Atlanto-Axial Instability

Avoid manipulation or “adjustments” to cervical spine

May require radiographs before anesthesia or before planned intubation (emergency intubation requires caution for neck position)

Avoid football, gymnastics, trampolines, soccer

https://emedicine.medscape.com/article/1180354-overview#a1
Exercise Capacity

• Adults with DS have lower cardiovascular capacity with lower mean peak Oxygen consumption, minute ventilation and heart rate during exercise (Pitetti, 1992)

• Contributing factors:
  o Lower lean body muscle mass
  o Lower muscle strength
  o Thyroid disorders
  o Hypotonic muscle tone
  o Obesity
  o Impaired sympathetic response to exercise

Barnhard & Connolly, 2007
Assessment Tools

- Test of Infant Motor Performance
- Alberta Infant Motor Scales
- Peabody Developmental Motor Scales
- Gross Motor Function Measure
- Pediatric Evaluation of Disability Index
- Timed up and Go Test (not Timed Up and Down stairs)
- Pediatric Balance Scale
Impact of Exercise

Chinxiao et al, 2013 Review of 10 RCTs

• Four different fitness outcomes reported in studies:
  o Balance (4 studies)
  o Muscle strength and endurance (7 studies)
  o Cardiovascular fitness (2 studies)
  o Body composition (3 studies)
Treadmill Training in Infancy

- Ulrich 2001
  - 30 subjects, RCT
  - TT from sitting unsupported until 3 independent steps
  - Home treadmill for 8’ per day 5x/wk
  - TT group walked 101 days earlier (ave 20 mo v. 24 mo)

Higher intensity helps reach 6 other motor milestones and walking even 2 months before low intensity
Bicycle Training
Orthotics

Used to improve “flat feet” (pes planus), improve postural stability, balance and motor skills

Most commonly used are SupraMalleolar Orthotics (SMOs) or customized foot orthotics as kids get older
Results of Using SMO

Randomized controlled trial of 14 kids with DS, ages 3.5-8 yo

- Improvement in balance ($p=.027$)
- Improvement in gross motor skills on the standing, walking, running ($p=.001$) and jumping ($p=.0001$) sections of the GMFM

(Martin, 2004)
Orthotics

Before walking?

• Looper, Ulrich, 2010
  o Infants with DS who used SMO pre-walking had lower scores on the GMFM one month after onset of walking than those who did not use SMOs

• No difference in onset of walking between groups

*However,*

Some infants won’t be able to stand without orthotics
Other Interventions

Hip Helpers

Abdominal Binder