Current Topics in the Therapies: Physical Therapy

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Learning Objectives

- Review normative data on gross motor skill development in children with Down syndrome related to developmental expectations and program planning.
- Provide an update on evidence for the use of selected interventions for gross motor skill development:
  - early intervention
  - treadmill training
  - use of orthotics and
  - strength/endurance training.
Varying Development with DS

- How variable is development in children with DS?

- How should the variation be addressed by families and health care providers in program planning?
Gross Motor Function Measure

- Standardized test used to assess gross motor skill development
- 88 or 66 items to examine:
  - Lying & rolling
  - Sitting
  - Crawling & kneeling
  - Standing
  - Walking, running & jumping
- Demonstrated psychometric properties with CP & DS for children up through six year GM skills
GMFM Data for Typically Developing Children
Motor Growth Curve Project in Canada

- One hundred and twenty one children assessed with the GMFM in Ontario between the ages of 1.7 months and six years.
- Children subdivided into mildly impaired and moderate to severely impaired.
  - Mild = movement patterns similar to TD children and sufficient muscle tone, strength and control to initiate, adapt and sustain movement during play.
  - Moderate = Able to initiate, adapt & sustain but not able to fully meet task requirements.
  - Severe = Difficulty in participating or completing.
Gross Motor Function Curve

Children with DS & mild impairment

Palisano et al, APMR, 2001 (www.canchild.ca)
Gross Motor Function Curve

Children with DS & moderate to severe impairment

Palisano et al, APMR, 2001
## Normative Data

<table>
<thead>
<tr>
<th>Milestone (90% attainment)</th>
<th>TD (AIMS Data)</th>
<th>DS (Palisano GMFM Data)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rolling</td>
<td>8.5 months</td>
<td>30 months</td>
</tr>
<tr>
<td>Sitting</td>
<td>7 months</td>
<td>12 to 18 months</td>
</tr>
<tr>
<td>Crawling</td>
<td>13 months</td>
<td>36-48 months</td>
</tr>
<tr>
<td>Standing</td>
<td>13 months</td>
<td>30 months</td>
</tr>
<tr>
<td>Walking</td>
<td>14.5 months</td>
<td>36 months</td>
</tr>
<tr>
<td>Running</td>
<td>-</td>
<td>67% at 72 months</td>
</tr>
<tr>
<td>Climbing steps</td>
<td>-</td>
<td>77% at 72 months</td>
</tr>
<tr>
<td>Jumping forward</td>
<td>-</td>
<td>84% at 72 months</td>
</tr>
</tbody>
</table>

AIMS = Alberta Infant Motor Assessment, Piper & Darrah, 1993
Comparison to Other Sources

- **Rolling**
  - 5 months (Chen & Woolley, 1978)
  - 6.5 months (Melyn & White, 1973)

- **Floor Sitting**
  - 8.5 months (Chen & Woolley, 1978)
  - 11.7 months (Melyn & White, 1973)

- **Crawling**
  - 12.2 (Melyn & White, 1973)
  - 17.3 (Fisher et al, 1964)
Comparison to Other Sources

- **Walking**
  - 15 months (Fisher et al, 1964)
  - 24 months (Melyn & White, 1973)
  - 28 months (Carr 1970)
  - 25% by age 2 (Carr, 1970)
  - 44% by age 2 (Centerwall & Centerwall, 1960)
  - 78% by age 3 (Centerwall & Centerwall, 1960)
  - 82% by age 3 (Hall, 1970)
  - 92% by age 3 (Palisano et al, 2001)
Varying Development with DS

- How should the variation be addressed by families and health care providers in program planning?

- Expectations
- Authorization for service
- Program Planning
Early Intervention Evidence

- Children who do not receive EI GM skill training do not keep up the rate of GM skill development as children who participate (Connolly, et al, 1993)
  - 10 children with DS compared to a no EI group
  - EI program was not discussed
- EI with an emphasis on motor skills development did not increase the rate of development (Mahoney et al, 2001)
  - 27 children with DS examined longitudinally over one year
  - No control group
- Therapeutic approach is not the key. (Uyanik et al, 2003)
  - Compared NDT to SI to motor activity programs
Treadmill Training of Infants with Down Syndrome Increases the Rate of Independent Walking

Treadmill training

- 8 min/day at .2 m/s for 5 days/week until infant could take 3 independent steps
- Start with beginning sitting
- Children in the treadmill training group walked independently earlier than control group (Ulrich et al, 2001)
- More intense training was not better in promoting earlier walking (Angulo-Barosso et al, 2008)

Video Link: Treadmill training Helps Down syndrome babies walk months early
## Treadmill Training

(Ulrich et al, Pediatrics, 2001)

<table>
<thead>
<tr>
<th>Outcome measure</th>
<th>Experimental Group</th>
<th>Control Group</th>
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<tr>
<td>Raises self to stand*</td>
<td>134 days (69.7)</td>
<td>194 days (115.8)</td>
</tr>
<tr>
<td>Walks with help**</td>
<td>166 days (64.6)</td>
<td>240 days (102.7)</td>
</tr>
<tr>
<td>Walks independently**</td>
<td>300 days (86.5)</td>
<td>401 days (131.1)</td>
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# Treadmill Training

(Ulrich et al, Pediatrics, 2001)

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<td></td>
<td>401 days (131.1)</td>
<td>23.9 attained walking</td>
</tr>
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(Ulrich et al, Pediatrics, 2001)
Effect of Different Treadmill Interventions

- **Low Intensity Generalized**
  - Trained 6 min/day, 5 days/week
  - Belt speed 0.18 m/s

- **High Intensity Individualized** 5 days/week

<table>
<thead>
<tr>
<th>Frequency (steps/min)</th>
<th>&lt;10</th>
<th>10-19</th>
<th>20-29</th>
<th>30-39</th>
<th>&gt;40</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration (Min/day)</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td>Belt speed (m/s)</td>
<td>0.18</td>
<td>0.18</td>
<td>0.19</td>
<td>0.20</td>
<td>0.22</td>
</tr>
<tr>
<td>Ankle Weight (%calf mass)</td>
<td>14</td>
<td>43</td>
<td>74</td>
<td>88</td>
<td>115</td>
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(Angulo-Barosso et al, Pediatrics, 2008)
## Effect of Different Treadmill Interventions

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<th>HI group</th>
<th>Lo group</th>
<th>Control</th>
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</thead>
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<tr>
<td>Mean age at walking onset</td>
<td>18.7 months (2.2)</td>
<td>21.1 months (4.8)</td>
<td>23.9 months</td>
</tr>
</tbody>
</table>

- Earlier walking, but not a statistically significant difference in age at walking onset between the HI and Lo groups
- Repeat study did show a significant difference, but of 2.1 months (Ulrich et al, 2008)
Do I Put Support Those Arches?

- Children with DS typically have feet with low or no arch
- When should you support the arch, or should you?
To Brace or Not to Brace

- Ankle and foot support has been found to be beneficial in improving balance in DS (Martin, 2004)
  - 17 children with DS from 3 to 6 years of age
  - Children with mild and severe laxity & pronation
  - Significant improvement in GMFM (walking, running and jumping) and Bruininks-Oseretsky scores after seven (7) weeks of use

Martin, Dev Med Child Neurol, 2004
To Brace or Not to Brace

- If calcaneal valgus alignment is greater than 10 to 15 degrees in weight bearing.
Strength and Endurance Training

- Good evidence that endurance training will;
  - Help to keep weight gain under control (Sharav & Bowman, 1992)
  - Improve balance (Carmeli et al, 2002)
  - Improve strength (Shields et al, 2008; Lewis & Fragala-Pinkham, 2005; Carmeli et al, 2002 & Mercer & Lewis, 2001;)
- Exercise prescription should be individualized.
- Participation in Special Olympics or other recreational activities should be encouraged.
Questions