Welcome
January 18, 2018
Presenter: Lori Potts, PT
Benefits of standing

- Bone & joint
- Bowel & bladder
- Breathing
- Blood
- Brain

What does the research say?
Levels of Evidence

1. Systematic Review
2. Randomized Controlled Trial (RCT)
3. Cohort Study
4. Case-Control Study, Case-Series
5. Mechanism-based Reasoning

Systematic Literature Review

Collects and critically evaluates multiple research studies.

Rich, NC (2005)
Randomized controlled trial (RCT)

The subjects are randomly allocated to each study group.

Rich, NC (2005)
Glickman L, 2010

Systematic Literature Review (Jan 1980 – Oct 2009)
112 studies identified; 39 studies met criteria

Increase BMD
Decrease tone
Improve ROM
<table>
<thead>
<tr>
<th>Condition</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMD</td>
<td>5 days/week, 60-90 minutes/day</td>
</tr>
<tr>
<td>Hip Stability</td>
<td>60 minutes/day in 30° to 60° total hip abduction</td>
</tr>
<tr>
<td>ROM- hip, knee, ankle</td>
<td>45-60 minutes/day</td>
</tr>
<tr>
<td>Spasticity</td>
<td>30-45 minutes/day</td>
</tr>
</tbody>
</table>

Reference
### Gross Motor Function Classification System

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level I</td>
<td>walks without limitations</td>
</tr>
<tr>
<td>Level II</td>
<td>walks with limitations</td>
</tr>
<tr>
<td>Level III</td>
<td>walks using a hand-held mobility device</td>
</tr>
<tr>
<td>Level IV</td>
<td>self-mobility with limitations; may use powered mobility</td>
</tr>
<tr>
<td>Level V</td>
<td>transported in a manual wheelchair</td>
</tr>
</tbody>
</table>

I

II

III

GMFCS

www.canchild.ca
What does the research say?

**Tone**

Joint ROM
BMD
Hip Stability
22 children with CP (Experimental n=12)(Control n=10)
30 min prolonged stretch to gastroc soleus in stander

Decrease in spasticity remained for 35 minutes after cessation of stretch
6 children with spastic CP (GMFCS Levels II and III)
45 min/d, 3 times/wk in prone stander, 9 sessions

Improved stride length, gait speed, stride time, stance phase time, double support time, muscle tone, and peak dorsiflexion angle during midstance.

Abstract
www.yourtherapysource.com
What does the research say?

- Tone
- Joint ROM
- BMD
- Hip Stability
Gibson S, 2009

5 non-ambulatory children with CP (ages 6 – 9 years)
1 h, 5 days per week, for 6 weeks

Hamstrings lengthened with standing
Caregivers reported improved ease of transfers/ADLs
Review:
Muscle deformity (joint contractures) in children with spastic CP may be due to the impairment of muscle growth and subsequent altered muscle adaptation.
What does the research say?

Tone
Joint ROM
**BMD**
Hip Stability
Systematic Literature Review
Fractures and low BMD
Children with severe CP (GMFCS IV and V)
32 studies identified; 5 studies met criteria

77% of children with moderate to severe CP present with low BMD in the femur.
Cohort Studies

A population of subjects is observed over time and compared to another group.

Prospective OR
Retrospective

Rich, NC (2005)
Uddenfeldt W, 2013

Retrospective Cohort, 536 children, 9-year data span

GMFCS
Levels I-III had similar fracture incidence as typical peers
Levels IV-V had stunted growth; increased risk of fractures

Reference
Uddenfeldt, 2013

Retrospective Cohort, 536 children, 9-year data span

Children at GMFCS levels IV and V who used standers had **four-fold reduction in fractures.**
Meta-Analysis

uses statistical methods to analyze multiple studies.

Rich, NC (2005)
Meta-Analysis
Effect of WB exercise on BMD for children with CP
118 studies identified; 3 studies met criteria

Weight bearing exercise has a significant effect on improving BMD of the femur in children with CP.
Case Control Study

Two groups of subjects (the case and the control) are exposed to different interventions to determine which group achieves a better outcome.

Rich, NC (2005)
Non-ambulatory children with CP
Passive standers (n = 4)
Dynamic standers (n = 5)

30 min/d, 5 d/wk for 15 months

Watanabe L. (2010)
www.mobilitymgmt.com
Children in dynamic standers showed significant increases in BMD and BMC and maintained increases longer.
Case Series

A group (series) of case reports on subjects with a pre-identified problem who are given similar treatment.

Subjects are observed for an outcome of interest. No control group is involved.

Rich, NC (2005)
Kecskemethy H, 2008

Non-ambulatory youth with CP (ages 6 – 21 years)
GMFCS Level V (n = 19)
GMFCS Level IV (n = 1)
Measured weight bearing during 30 min standing sessions

There is wide variance in the actual weight borne while in passive standers.
What does the research say?

Tone
Joint ROM
BMD
Hip Stability
Many children with cerebral palsy of GMFCS Levels IV-V have a normal hip at infancy that progresses to significant displacement and eventual dislocation.
Soo B, 2006

Cohort Study, 323 children
Mean duration follow up was 11 years 8 months

Incidence of hip displacement
GMFCS Level I = 0%
GMFCS Level V = 90%
Hägglund G, 2007

Cohort Study, 212 children
Followed from birth until 9-16 years of age

For children with severe limitations,
the risk of dislocation is highest between 2-5 years.
Occurs predominantly with spastic/dyskinetic CP.
Sweden
258 children born between 1992 and 1997
431 children born between 1998 and 2007

The risk of developing a dislocated hip in the whole population of children with CP has been estimated to be between 15% and 20%.
Measurement of migration percentage and acetabular index.

Migration percentage = \( \frac{AC \times 100}{AB} \). 

Migration percentage = \( \frac{AC}{AB \times 100} \).

David Scrutton, and Gillian Baird Arch Dis Child 1997;76:381-384
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Migration Percentage

>15%  dysplasia
>30%  subluxation
>100% dislocation
145 children followed for five years (from first x-ray)
Mean age at initial pelvic radiograph = 3.5 years
Group 1 = developed hip displacement
Group 2 = did not develop hip displacement

Which factors are predictors of developing MP > 40% within 5 years of the first x-ray?
MP (migration percentage)
HSA (head-shaft angle)
GMFCS Level
were significantly associated with an MP >40%.
Robin J, 2008

292 children with CP
Clinical measurement of FNA (femoral neck anteversion)
X-ray evaluation of NSA (neck-shaft angle)

Children with CP have increased FNA and NSA. Both deformities are related to displacement of the hip.
<table>
<thead>
<tr>
<th></th>
<th>GMFCS I</th>
<th>GMFCS II</th>
<th>GMFCS III</th>
<th>GMFCS IV</th>
<th>GMFCS V</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FNA</strong></td>
<td><img src="image1" alt="Image" /></td>
<td><img src="image2" alt="Image" /></td>
<td><img src="image3" alt="Image" /></td>
<td><img src="image4" alt="Image" /></td>
<td><img src="image5" alt="Image" /></td>
</tr>
<tr>
<td></td>
<td>FNA = 30°</td>
<td>FNA = 36°</td>
<td>FNA = 40°</td>
<td>FNA = 40°</td>
<td>FNA = 40°</td>
</tr>
<tr>
<td><strong>NSA + MP</strong></td>
<td><img src="image6" alt="Image" /></td>
<td><img src="image7" alt="Image" /></td>
<td><img src="image8" alt="Image" /></td>
<td><img src="image9" alt="Image" /></td>
<td><img src="image10" alt="Image" /></td>
</tr>
<tr>
<td></td>
<td>NSA = 136°</td>
<td>NSA = 141°</td>
<td>NSA = 149°</td>
<td>NSA = 155°</td>
<td>NSA = 163°</td>
</tr>
<tr>
<td></td>
<td>MP = 8%</td>
<td>MP = 13%</td>
<td>MP = 25%</td>
<td>MP = 37%</td>
<td>MP = 46%</td>
</tr>
</tbody>
</table>

Robin J (2008)
“...Displacement of the hip in patients with CP can be explained...by the abnormal shape of the proximal femur, as a result of delayed walking, limited walking or inability to walk.”
Weight bearing and functional movement may have a role in preventing secondary changes to the hip.

“It may be the excessive anteversion and coxa valga that is partly responsible for the very high rates of hip displacement in children in GMFCS levels IV and V, rather than adductor spasticity.”
18 children, age 3-18 years
Severe cerebral palsy
Standing shell used 40 min/day
The Standing shell was developed in Sweden in the late 1980s.
Non-dynamic WB in standing shell did not affect whole body BMD.

In children with spasticity, non-dynamic WB in standing shell worsened hip displacement.
Martinsson C, 2011

Purpose:
To study the effect of 1 year of daily, straddled weight-bearing on hip migration percentage (MP) and muscle length in children with cerebral palsy who were nonambulatory.

Reference
97 children; all were non-ambulant, GMFCS III-V
Ages 2-6 years
Spastic, dyskinetic or mixed CP

**Supported standing for 1.5 hours daily for one year.**
<table>
<thead>
<tr>
<th>Study Group N=14</th>
<th>SG 1</th>
<th>Post-hip surgery and abducted standing</th>
<th>N=3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SG 2</td>
<td>Abducted standing only</td>
<td>N=11</td>
</tr>
<tr>
<td>Control Group N=83</td>
<td>CG 1</td>
<td>Post-hip surgery and standing</td>
<td>N=20</td>
</tr>
<tr>
<td></td>
<td>CG 2</td>
<td>Standing only</td>
<td>N=63</td>
</tr>
</tbody>
</table>
Straddled weight-bearing, 1 hour per day may
• reduce the MP after adductor-iliopsoas-tenotomies
OR
• prevent an MP increase...in children with CP who did not need surgery.

Larger studies are needed to confirm the results.
Postural management consensus statement
Integrated approach: equipment, activity, surgery

GMFCS Levels IV and V

After birth (when possible): prone lying
6 months: supported sitting
12 months: supported standing
Integrated approach: postural management, orthoses, tone management, surgery.

Postural management equipment before 18 months of age for children with bilateral CP GMFCS Levels III, IV, V may help decrease incidence of hip pathology by age 5.
If child cannot walk more than 10 steps by the age of 30 months and has MP >15%, positioning equipment should be used. Programs should include hip abduction.

Interventions may include
- Lying support (night use recommended)
- Seating system (six hours per day recommended)
- Standing support (one hour per day recommended)
Clinical Tool - Focus on Hip Health
Positioning for Children GMFCS Levels IV-V:

Specific hip abduction recommendations

After birth: supine lying with hip abduction, flexion, ER
5-6 months: supported sitting
9-10 months: supported standing
10+ months: supported walking

Reference
An appraisal:

“We need to develop a means to implement a postural management programme for these children in a manner that does not adversely impact, but instead enhances, their environment and participation.”
Is there a predictor of independent walking?
Secondary data analysis of an observational cohort study

80 children with CP, ages 2 - 6 years
GMFCS Levels II and III

Is there a predictor of independent walking?
A sit to stand activity was the only significant predictor of taking ≥ 3 steps independently.

This correctly identified a Walker or Non-walker 75% of the time.
Young people’s experience with standing frames

Attitudes – examples:

- Understanding the benefit helps to endure discomfort of standing
- Standing can enable access to activity OR be limiting
- Peer interaction can be enhanced OR it can separate
- Specific standing opportunity may or may not be a choice
Young people’s experience with standing frames

Challenges – examples:

- Difficulty with transfer OR caregiver expertise
- Lack of control OR having control over position
- Design of frame for function and/or appearance
- Size of stander and space requirements
Clinical Applications

**Tone:**
Reduced spasticity does not last a long time after standing session. Supported standing may be followed with an activity that would benefit from reduced tone (walking practice, hygiene/dressing care)
Clinical Applications

**Joint ROM**

Sustained standing (45-60 min) for passive stretch may show greater improvements. To increase stretch, consider hip extension position, use of knee immobilizers, use of dorsiflexion wedges.

Further research needed. Is development of joint contracture related to decreased muscle growth?
Clinical Applications

**BMD**

Supported standing can begin at 9-10 months old. Passive weight bearing to maintain BMD. Dynamic, active WB and muscle use to increase BMD. Incorporate sit-to-stand transfers to load/unload long bones. Assure that child is bearing weight through the legs; use minimum necessary postural supports and straps.
Clinical Applications

Hip stability
Aim for 30° to 60° total hip abduction for non-ambulatory children with spastic CP (15° to 30° per LE.) Avoid 0° abduction position.
Remember:
lack of walking before age five (with or without device) contributes to excessive femoral neck anteversion and hip shaft angle.
Clinical Tip:

An isosceles triangle has 60° in each angle. For a quick estimate to achieve 30° abduction per hip, approximate the distance between the child’s feet as equal to the child’s inside leg length.

Meeting this requirement becomes more challenging as the child’s height increases. (Note: for the total foot-to-foot distance, you’ll want to add in the distance between-hips!)
For more information visit:
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