Wearable Canes: Improve motor, concept, language and social skills in toddlers w/mobility visual impairment

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City College of CUNY
Disclosure
Safe Toddlers Inc

Support

Slides and references @SafeToddlers
Ysabella 3 years old - CVI
Has anyone here ever said...

Sitting idly is worse than walking with a visual impairment?

1840s Samuel Gridley Howe wrote: “Do not too much regard bumps upon the forehead, rough scratches or bloody noses; even these may have their good influences. At the worst, they affect only the bark, and do not injure the system like the rust of inaction” (Buell, 1962, p. 65).
Has anyone here ever said

In the 1930s Dr. Thomas Cutsforth, a prominent psychologist whose classic work *The Blind in School and Society* wrote, “when the child (who is blind or visually impaired) has once learned to walk, it is well to omit any form of manual guidance about the house and to permit the child to become oriented himself, even at the expense of minor injuries and emotional distress of both the child and the other members of the family” (p. 21-22).
Has anyone here ever said

In 1956, renowned educator of the visually impaired Berthold Lowenfeld recommended that “young children (who are blind or visually impaired) must learn to walk without help of any kind in familiar territory. What is familiar territory expands as they grow older, until they learn to venture out into places that are new to them. When the time comes to do this, they should learn to use the cane. Usually this is found practical only after a youngster is fourteen years of age, more often older than that”.

• Have you ever said something similar to a family?
Motor skill delays are inevitable in MVI

• Bakke, et al., (2019) reviewed 1113 articles on motor skills with visual impairment. “... motor development in children with visual impairment is expected to be different from that in typically developing peers”.

• Studies focused on changing the environment and/or offering adapted physical therapy training to address the motor skill impact on this population.
Motor skill delays are inevitable in MVI

• None of the research reviewed sought to declare these motor skill deficits as, avoidable.

• Instead, researchers overwhelmingly agreed that severe visual impairment and blindness resulted in motor skill delays due to a lack of anticipatory preview of the environment, and nothing had been found that can prevent these “inevitable motor skill delays” observed in children who are congenitally blind and visually impaired.
What do bruises teach?

• Skellenger and Sapp (2010) wrote that “a major overriding role of O&M specialists working with learners in the early childhood years will be the facilitation of the child’s typically innate enjoyment of exploration, which is so often thwarted by absent or impaired vision” (p. 168).

• The role of the practitioner was to continue with enrichment activities until such time as these students with visual impairment demonstrated “higher developmental skills that indicate readiness to begin long-cane instruction” (p. 190) and lack of competence with the long cane was considered probable through age five.
Where is the logic in early intervention for VI?

Is it logical?

‘because blind toddlers are unable to physically and cognitively use the long cane correctly to achieve consistent tactile path information, that they benefit from collisions.’

‘When they are able to use the long cane, they no longer benefit from collisions.’

This is not logical, because everybody needs path information to move about safely, especially children aged five and younger.
No one benefits from collisions

• No one benefits from collisions

• No one benefits from collisions

• There is no benefit from collisions

• Collisions can benefit sighted kids – not blind kids.
What do bruises cost?

Poor motor skill development

- Slow pace,
- Halting, protective gait
- Delay in walking free of an adult’s hand
- Bruises from colliding with unseen obstacles

Wyver and Livesey (2003) review of motor skill research on children with visual impairment concluded, “...findings are generally consistent despite the studies being conducted in a wide range of settings, in a variety of countries and with children with varying degrees of visual disability... **there is strong evidence of an adverse impact of visual impairment on motor development**”
How far are they behind?

• Rosen stated that children born severely visually impaired or blind were typically 3-6 months behind in gross motor skill development, and reasons for delays included "...apprehensions about moving in space without vision."

• The concern, Rosen explained, was that gross motor skills, "the ability to move about and explore is essential to global development and forms the foundation for cognitive development."
On target or not?

• Family report on 15 months old – ONH don’t know if she had light perception

  She’s cruises around the house and is very mobile. She does this following walls or walking while pushing toys. She has a very good sense of her surroundings but I think she is afraid to walk without having that security of holding onto something. She will walk across a room unaided following a voice, but is scared.

• We don’t know of any learning disabilities, but she is still non verbal
### Developmental Milestones: Gross motor

<table>
<thead>
<tr>
<th>Mobile phase</th>
<th>2 Months</th>
<th>9 Months</th>
<th>12 Months</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Moves</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rolling</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Squirming</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attempts to crawl</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>When held, steps with alternate feet</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cruising</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crawling, bottom shuffling, creeping or bear walking</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
On target or not?

• Professional report on 24 months old – blind
  • On target w/gross motor. Gets scared walking outside
  • Delayed speech
  • Push toy: shopping cart

• When left to play on own?
  • Explores everything

• Reason for WWC?
  • Increase confidence walking (especially outside and in crowds); Build concepts; Work on running
Developmental Milestones: Gross motor

<table>
<thead>
<tr>
<th>Phase</th>
<th>Moves</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highly mobile phase</td>
<td>15 MONTHS: Walks alone, feet wide, arms up, often falls, bumps into furniture, Stands from sitting w/out support</td>
</tr>
<tr>
<td></td>
<td>18 MONTHS: Walks well with arms down, Start n stop safely, Runs carefully, but cannot avoid obstacle</td>
</tr>
<tr>
<td></td>
<td>2 YEARS: Runs avoiding obstacle</td>
</tr>
</tbody>
</table>
On target or not?

• Family report on 38 months old – CVI
  • My son is able to walk however he will fall or hit his head of something is in front of him. He easily runs into doors and walls. Trips over planters and steps on his younger sibling.
  • No mobility device

• When left to play on own?
  • Run into walls when overly excited and just walk and explore around.

• Reason for WWC?
  • I think this cane will allow him to be more comfortable when he is outside. At this time he is constantly hunched over and turns his foot outwards and lets it slide across the ground when walking. I think the cane will help stop that feature and feel more comfortable with his low vision.
Watch as 2 year 4 month old child uses her cane to navigate, probe and learn what is in her world. Toddlers can and should start walking.

You will see she does not just push a cane, but heavier canes with rolling tips, which the child does not understand the vital information they give her to actually probe to touch and identify the information on cane usage with preschoolers.

[Image of a child walking with a cane]
Mobility visual impairment

When walking or running, the inability to visually avoid obvious obstacles
Preverbal MVI assessment

Observe a child aged one to five years old during free play for twenty minutes, observe and score behavior. A score of nine or lower indicates a mobility visual impairment and that the current mobility tool is not effective.

A. Affect

<table>
<thead>
<tr>
<th>Score</th>
<th>Visible signs of emotional state</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Hand aggression (eye poking, punching, hitting self/others)</td>
</tr>
<tr>
<td>2</td>
<td>Hands held mid body to near head, arms bent</td>
</tr>
<tr>
<td>3</td>
<td>Hands held at sides, long straight arms</td>
</tr>
<tr>
<td>4</td>
<td>Arm swing; cane manipulation</td>
</tr>
<tr>
<td>5</td>
<td>Appropriate to developmental potential</td>
</tr>
</tbody>
</table>
Preverbal MVI assessment

<table>
<thead>
<tr>
<th>Score</th>
<th>Observable moving about the environment</th>
<th>Self-generated relocation efforts</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Stationary; no attempt to relocate</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Moves arms and trunk only</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Constant contact with objects</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Walks across/standing open space</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Appropriate to developmental potential</td>
<td></td>
</tr>
</tbody>
</table>
Preverbal MVI assessment

C. Cognition

<table>
<thead>
<tr>
<th>Score</th>
<th>Ability to communicate wants, needs and thoughts to others</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Quiet</td>
</tr>
<tr>
<td>2</td>
<td>Verbalizations</td>
</tr>
<tr>
<td>3</td>
<td>Babbling; echolalia</td>
</tr>
<tr>
<td>4</td>
<td>Purposeful communication</td>
</tr>
<tr>
<td>5</td>
<td>Appropriate to developmental potential</td>
</tr>
</tbody>
</table>
Wade 5 years old - Blind
The bar chart shows the count of gender for a sample size of N=278. The chart indicates that there are 124 girls, 104 boys, and 50 individuals whose gender is not stated.
### Age of child (months) by motor milestone before wearable cane (n=202)

#### Motor milestone

<table>
<thead>
<tr>
<th>Milestone Description</th>
<th>Frequency</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 months - Stands</td>
<td>13</td>
<td>34.2303</td>
<td>26.768</td>
</tr>
<tr>
<td>11 months - Cruises</td>
<td>17</td>
<td>34.4115</td>
<td>20.648</td>
</tr>
<tr>
<td>12 months - Walks with Assistance</td>
<td>69</td>
<td>43.3623</td>
<td>26.05228</td>
</tr>
<tr>
<td>15 months - Walks wide-based gait, cannot avoid obstacles</td>
<td>89</td>
<td>43.6629</td>
<td>28.41372</td>
</tr>
<tr>
<td>18 months - Walks well, runs cannot avoid obstacles</td>
<td>6</td>
<td>46.00</td>
<td>11.57584</td>
</tr>
<tr>
<td>24 months - Runs able to avoid obstacles</td>
<td>1</td>
<td>25.00</td>
<td></td>
</tr>
<tr>
<td>Motorically impaired</td>
<td>7</td>
<td>46.7143</td>
<td>9.87783</td>
</tr>
</tbody>
</table>

#### Additional Notes
- The data represents the age of children at which they achieved specific motor milestones before wearing a wearable cane.
- The chart displays the frequency of children reaching these milestones at different ages, with mean and standard deviation values provided for each milestone.
Age of child (months) by learning ability (n=113)

Learning ability
- Non-specific comments
- Intellectually disabled
- Developmentally delayed
- Within normal limits

Non-specific comments
Mean = 41.1667
Std. Dev. = 26.32259
N = 12

Intellectually disabled
Mean = 66.4583
Std. Dev. = 41.89426
N = 24

Developmentally delayed
Mean = 42.2027
Std. Dev. = 16.79936
N = 74

Within normal limits
Mean = 32.6667
Std. Dev. = 18.44813
N = 3

Age of child (months)
Gross motor milestone by learning ability before wearable cane

- **Learning ability**
  - Non-specific comments
  - Intellectually disabled
  - Developmentally delayed
  - Within normal limits

<table>
<thead>
<tr>
<th>Gross motor milestone</th>
<th>Count</th>
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<tbody>
<tr>
<td>10 months - Stands</td>
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</table>
Age of child (months) by solitary play (n=115)

- Crawls around
- Stays in one location
- Walks around (bumps into stuff)
- Explores everything
- Always by me
- Cannot be left alone
- Hits self, becomes angry frustrated
- Climbs on furniture, cruises

Crawls around
Mean = 46.1075
Std. Dev. = 31.25762
N = 16

Stays in one location
Mean = 49.6961
Std. Dev. = 29.66635
N = 71

Walks around (bumps into stuff)
Mean = 36.9375
Std. Dev. = 14.29438
N = 16

Explores everything
Mean = 24.00
Std. Dev. =
N = 1

Always by me
Mean = 54.00
Std. Dev. =
N = 1

Cannot be left alone
Mean = 34.00
Std. Dev. = 20.28427
N = 2

Hits self, becomes angry frustrated
Mean = 62.00
Std. Dev. =
N = 1

Climbs on furniture, cruises
Mean = 27.00
Std. Dev. = 9.81495
N = 7
Age of child (months) by type of mobility device before wearable cane (n=226)

Type of mobility device
- Homemade AMD
- PT Device (walker, gait trainer, AFOs)
- Long cane
- None
- Push toy
- Adapted long cane
- Toddler cane (wearable)
- Baton, brush

- Homemade AMD
  Mean = 27.00
  Std. Dev. = 10.04988
  N = 5

- PT Device (walker, gait trainer, AFOs)
  Mean = 54.4167
  Std. Dev. = 27.62468
  N = 24

- Long cane
  Mean = 42.6913
  Std. Dev. = 14.21459
  N = 46

- None
  Mean = 40.08
  Std. Dev. = 25.32868
  N = 125

- Push toy
  Mean = 52.3333
  Std. Dev. = 48.43067
  N = 18

- Toddler cane (wearable)
  Mean = 47.00
  Std. Dev. = 1
  N = 1

- Baton, brush
  Mean = 54.00
  Std. Dev. = 1
  N = 1
The PT Device fix...

- She just received orthotics in her shoes yesterday - she seems to have increased stability with these.
- Her physiotherapist wants us to wait before offering a non-weight bearing device.

- 28months – tunnel vision - Traveling independently is a major concern, he learned to walk when he turned two last October, but does not notice obstacles, even ones that are consistent in his own home. He trips over the step going from inside to outside of his home every time. He does not notice drop offs such as the sidewalk or even the steps in his own home. This is a major safety concern.
Three measurements
Akira 3 years old - Blind

February 3, 2019

May 17, 2019
March 28, 2018
Prefer sedentary lifestyle

• No child five and younger prefers sedentary lifestyle – they arrive at the conclusion that the best, safest, least painful way to exist is to avoid moving.

• No child prefers to be passive.

• Experience with wearable canes shows that when children with MVI are provided with consistent tactile path information they blossom.
  • 1-3 years old – transition to wearing cane takes encouragement. They may resist new things initially, attempt to control by saying no.
  • 3-5 years old- most frequent phrase: ‘They take to it like a duck to water, start running, don’t want to take it off.’
Unknown reason for gross motor delays

• The reason gross motor is observably different is a lack of consistent path information.

• Mobility visual impairment and blindness robs children of their path information

• When worn everyday most of the day, wearable canes provide consistent tactile path information (CTPI).
When we finally provide them with CTPI

• They run
• They explore
• They begin speaking
• They show joy
• They begin to trust

• Providing children with consistent tactile path information (CTPI) reverses developmental delays.
Safe Toddlers safety cap