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Babyproofing Blind Walking: A Study the Physical Activity Outcomes Before and After Introducing the Pediatric Belt Cane

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Abstract:

Introduction: In this study, we examined whether the Pediatric Belt Cane would be able to resolve the poor activity levels and walking skills observed in children with a mobility visual impairment or blindness (MVI/B) and due to their overexposure to walking without an assistive safety device. Our measures were pre/post scores from the Birth to 6 Orientation and Mobility Skills Inventory (B6OMSI) scores and professional O&M assessment.
Method: Fifty participants completed pre/post B6OMSI interviews and submitted videos of their children with an MVI/B over twelve weeks. Participants enrolled using an online intake form and participated in interviews and video sharing remotely. We compared B6OMSI scores, and time spent engaged in motor skills pre/post. Separate comparisons were made for age, gender, and degree of visual impairment groups.
Results: B6OMSI motor scores and the amount of time spent walking were significantly higher at posttest. Children with an MVI/B's improved safety through wearing the Pediatric Belt Cane was shown to have a significant impact on participants with an MVI/B's spatial relationships, willingness to walk, and walking skills.
Discussion: This studies' outcomes are consistent with prior studies results, coming to the singular conclusion that safe mobility is a medical necessity for children with an MVI/B to walk. The high rate of adult attrition from the study; those adults who stopped providing an assistive safety device to participants with an MVI/B, suggests a lack empathy for children for whom their impairment makes walking without tactile warning extremely harmful and causes significant walking delays.
Information for Practitioners: The results of this study show that blindness-caused walking delays in children with an MVI/B can be prevented by consistently providing them with an assistive safety device such a Pediatric Belt Cane during their daily recommended physical activities hours.

Infants are expected to take their first wobbly, hands free step any time after age eight months but before they reach eighteen months (Adolph & Franchak, 2017). Once infants let go and take their first step, the amount of independent walking time and walking ability are expected to improve. After six months of walking experience, a toddler should demonstrate a narrow base of support, increased step length, adult-like stability and inter- and intralimb coordination (Clark & Phillips, 1993; Dusing & Thorpe, 2007; Vieira, Carvalho, Barela, & Barela, 2019). By eighteen months, medical attention is advised for infants who are not walking solo during their recommended five to six hours of daily physical activity (Bjornson, et al., 2011).

One-year-old children (i.e., 12 -23 months) with congenital or early onset mobility visual impairment or blindness (MVI/B) do not walk independently when evaluated using these standard age-based descriptive milestones (Ambrose-Zaken, 2023, 2022). Instead, infants with an MVI/B exhibit blindness-induced walking impairments, caused by their insufficient visual reaction distance and reaction time to obstacles in the path. Children's blindness-caused walking delays are due to an overexposure to harmful collisions and result; in among other concerns, an overreliance on outside handheld support (Ambrose-Zaken, 2023; Bucci, et al., 2017; Mallau, Vaugoyeau & Assaiante, 2010).

Ambrose-Zaken (2023) studied blindness-caused walking delays in 562 children with an MVI/B between ages 8 and 180 months (n=543, M=41.49 months; Σ=25.49). She reported that over 75% of the children with an MVI/B were unable to walk solo, defined as walking without handheld assistance. Parents expressed difficulty providing their children with a safe way to participate independently in their recommended daily physical activity. They reported a major challenge was that their children were unable to use handheld mobility tools correctly or consistently. These findings were consistent with previous studies of this population (Ambrose-Zaken, Chong & Enzenauer, 2024; Ambrose-Zaken, 2022, Ambrose-Zaken, et. al., 2019).

Research on children with an MVI/B has shown that providing a Pediatric Belt Cane for constant detection of and protection from obstacles improves children with an MVI/B gait and independent walking milestones (Ambrose-Zaken, Chong & Enzenauer, 2024; Ambrose-Zaken, 2022, Ambrose-

Zaken, et al., 2019). Ambrose-Zaken, et al. (2024) demonstrated that 11 children with cerebral visual impairment significantly improved their gait after eight weeks of having constant protection, touch and sound feedback provided by the Pediatric Belt Cane. Ambrose-Zaken (2022) reported on thirty-five children with an MVI/B aged 14–69 months (M =33.2 months) who used a Pediatric Belt Cane regularly over three months and demonstrated significantly higher walking milestones.

There is a need to continue to evaluate children with an MVI/B's walking abilities when provided with consistent safe mobility in addition to using metrics such as motor milestone achievement and improved gait analysis. Early walking is measured in hours per day. Therefore, we sought to demonstrate the relationship between increased safe mobility and amount of physical activity in young children with an MVI/B by comparing motor skill activity before and after obtaining safe mobility.

Aim of the Study

The aim of the present study was to evaluate motor skill activity in children with an MVI/B before and after introduction of a Pediatric Belt Cane, using the Birth to 6 Orientation and Mobility Skills Inventory (B6OMSI) and coding motor skill activities in pre/post videos (Ambrose-Zaken, 2022; Baughn, 2021). The research questions are:

1. Does age, gender, or degree of visual impairment affect the B6OMSI score, or time spent in motor skill activities?
2. Is there a significant difference in children with a MIV/B's time spent engaged in seven mutually exclusive motor skill activities: lying down, sitting, standing with assistance, walking with assistance, standing solo, walking solo, and running, before and after introduction of the Pediatric Belt Cane?

By establishing a repeated pattern of improved walking after introducing a Pediatric Belt Cane across a diverse group of children born with an MVI/B, we will further support the designation of safe mobility as a medical necessity to walk. Safe mobility is defined as consistent, reliable touch and sound detection of and protection from obstacles in the immediate path ahead of the child. Infants with an MVI/B can achieve consistently safe mobility when wearing a Pediatric Belt Cane.

METHOD

Participants

Data on children with an MVI/B were collected remotely through Pediatric Belt Cane online intake form, one-on-one B6OMSI video-call interviews, and subject-submitted videos. Inclusion criteria were that children were blind or mobility visually impaired, aged between 10 and 60 months, who had the physical potential to walk (e.g., did not require a wheelchair). The degree of visual and motor impairment was based on adult reports and video observation. Blind was defined as no light perception; mobility visual impairment was defined as having impaired vision such that they cannot visually avoid obstacles (Ambrose-Zaken, 2022). Excluded were individuals who were outside the age, motor, or vision impairment parameters.

A total of 124 intake forms and letters of consent were submitted for learners with an MVI/B aged 11- to 154-months (M = 39.25 months, SD=27.42). Just over 11% were above the age of 60 months and another 11% were motor impaired, with 4% having a vision impairment above the MVI threshold. Ten percent did not complete the pre-B6OMSI, resulting in 81 participants (65.3%) who completed the B6OMSI and submitted a pre-video. Fifty of them (61.7%) obtained a Pediatric Belt Cane and completed the study. Table one provides the demographic characteristics of all in-take forms and the those who were included in the analyses.

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Insert Table 1

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Measures

The Pediatric Belt Cane Intake Form. The online intake form collects background information, learning skills, motor skills, related service and mobility tool use (Ambrose-Zaken, 2022 & 2023).

B6OMSI Interview. The B6OMSI assesses orientation, mobility, concept, perception, cane, and communication (Baughn, 2021). A total of 213 items are divided over 37 subscales. The specific activities scored within the B6OMSI motor skill category were standing, walking, running and quality of

independent walking (New Mexico School for the Blind, 2021). The interviewer asks the child's representative to choose a whole number between 0 and 5 to rate their child's proficiency defined as: zero, skill not applicable; one, doesn't demonstrate skill; three and four, often or sometimes needs assistance to demonstrate skill; and five consistently demonstrates skill without assistance.

Procedure

The Office of Research Compliance, Integrity & Safety of Northern Illinois University (NIU) has given permission for the collection of data using the in-take form, the B6OMSI, and videos. The project provided flyers to professionals and families at conferences and offered participation in the project as an option for obtaining a free Pediatric Belt Cane. In addition, general calls were made on different social media websites.

Interested applicants completed the online in-take form. Project staff contacted the applicants, conducted the B6OMSI pre-interview and collected pre-video. Participants received Pediatric Belt Canes and the multi-media curriculum. Project staff collected 12 weeks of videos from participants, conducted the post-B6OMSI interview, and analyzed the data. The video coders logged the number of seconds the children spent demonstrating the eight specific motor skills during the pre- and final- video footage. Three clinical staff were trained in the video observation system. Interrater reliability was consistently above 97% and the corrected agreement score was 100%.

Statistical Analysis

SPSS version 29 was used for statistical analyses. Sample characteristics were analyzed and presented using descriptive statistics. Average B6OMSI scores of different subgroups, age, gender, and degree of visual impairment were analyzed by means of one-way ANOVAs. Association between B6OMSI Cane sub scores of reaching/holding and long cane skills were also examined by means of a Pearson's r correlation. Differences in B6OMSI scores and time spent in specific motor activities between children before and after introduction of the Belt Cane were analyzed using paired t-tests. The main analyses, and the hypothesized directions to test the efficacy of providing children with an MVI/B under five with safe mobility using a Belt Cane are summarized in Table 2.

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Insert Table 2

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Results

Sample. Fifty children (60% boys) with an MVI/B were aged 11 to 56 months old (M=29.04, SD=11.41). The children resided in 22 states in the US and 7 countries. The children's ethnicities were Caucasian 64%, Hispanic 16%, African American 6%, Asian 8%, and Bi-racial 4%. The remaining 2% did not respond. The subjects presented with twelve visual impairment diagnoses reported on the intake form. The two most common diagnoses were Optic Nerve Hypoplasia (24%) and Cerebral Visual Impairment (18%). Groups were about equally divided between blind and mobility visually impaired. Participants' learning ability was reported as on-target (46%), developmentally delayed (42%) or intellectually disabled (12%).

Related Services. Participants' most frequent related service was physical therapy (82%). Over half of the children with an MVI/B (56%) received O&M therapy.

Self-Reported Mobility Tools. Over half (52%) of the participants reported using mobility tools prior to obtaining a Belt Cane. The reported mobility tools, in order of frequency, were walkers/gait trainers (22%), long canes (18%), push toys (8%), and rectangular canes (2%). Participants could select any combination of four locations (School, Home, Therapy, Other) where the children with an MVI/B used their mobility tools. At intake, 64% did not respond. Of the remaining, 22% chose Home as at least one location where the children used the mobility tool and 14% reported that the children only used the mobility tool at School and during scheduled Therapy sessions.

Differences Between Age, Gender, Degree of Visual Impairment on B6OMSI Scores and Time Spent Walking Solo Prior To and After Obtaining a Belt Cane

A one-way ANOVA found that the adult B6OMSI scores of the children's walking ability were not significantly different depending on the age of children prior to getting a Belt Cane $F(3, 43) = 3.74$, $p > .05$ or after using their Belt Cane $F(3, 30) = .201$, $p > .05$. A one-way ANOVA of motor skills during

pre-videos revealed that, prior to getting a Belt Cane, the time spent walking was significantly different by age group. On average, three-year-old children (M=64.55, SD = 68.48, 95% CI [18.54-110.56]) walked significantly more than the one- (M=15.67, SD = 31.59, 95% CI [1.29-30.05]), two- (M=28.86, SD = 34.66, 95% CI [8.84-48.87]) and four-year-old (M=20.00, SD = 40.00, 95% CI [-43.65-83.65]) children. After introduction of the Belt Cane, there was no difference between age groups in time spent walking $F(3, 46) = .690$, $p > .05$, one- (M=75.95, SD = 79.87, 95% CI [39.60-112.31]), two- (M=101.64, SD = 101.70, 95% CI [42.92-160.36]), three- (M = 106.00, SD = 127.48, 95% CI [20.36 – 191.64]) and four-year-old (M=37.50, SD = 40.32, 95% CI [-26.66-101.66]) children.

There was no significant difference in amount of walking by gender before getting the Belt Cane $F(1, 48) = .181$, $p > .05$ or after introducing the Belt Cane $F(1, 48) = .632$, $p > .05$. Pre/post there was no difference in amount of time spent engaged in walking activities based on degree of visual impairment before $F(1, 48) = 4613.85$, $p > .05$) or after $F(1, 48) = 712.84$, $p > .05$).

Reach and Hold Ability Correlation to Cane Skill Ability. A Pearson correlation coefficient was computed to assess the relationship between the B6OMSI sub scale ability to reach and hold objects and sub scale ability to use long canes. There was a significant inverse correlation between sub scales ($r(34) = .609$, $p = <.05$). On average, the children scored high on the reaching and holding subscale (M= 4.31, SD = 1.30, 95% CI, [2.78-3.68]) and low on the cane skills scale (M=1.08, SD = .578, 95% CI [1.80-3.18]). Their scores indicated they were independently able to reach and hold objects and they did not demonstrate long cane skills. This suggests a child's ability to reach and hold objects is not correlated to long cane ability.

Pre-Video Observation Motor Skill Activities and Mobility Tool Usage. In the 10,934 seconds of pre-video footage, eight participants (16%) used a mobility tool for .04% of time on video, meaning that 99.96% of the time the children were engaged in motor activities either with adult assistance or without any protection from a mobility tool. Most (81.3%) of the children's time was spent inactively. In three hours, the fifty children spent 1 hour, 23 minutes sitting quietly and 1 hour standing and walking

with adult assistance. The 50 children with an MVI/B only walked or ran solo for a total of 25 minutes, or two minutes each.

The evaluation conclusions from the three pre-tests were the same, the children with an MVI/B did not demonstrate active solo play, independent motor skills, or independent mobility tool use. At intake, the children with an MVI/B had limited access to mobility tools and they were not provided mobility tools in all settings.

Why do you want a wearable white cane? The participants responded with 38 unique statements to the question, "Why do you want a wearable white cane?". The unifying sentiment across these statements was that the children's MVI/B made it unsafe for them to move about without assistance, and they were seeking an effective tool that their children could easily use to feel safe, build confidence, and increase their child's daily independent walking.

Comparing Participants Pre- and Post-B6OMSI Walking Score. The participants pre-B6OMSI and post-B6OMSI Walk sub scale scores were compared using a paired samples t-test. The adults rated their children's walking significantly higher pre to post ($t= -4.138$, $df-33$, $p<.05$). Pre-walking ($M=3.88$, $SD = 1.20$, 95% CI [-1.27 - -.435]) and post ($M=4.74$, $SD = .657$, 95% CI [-1.05- -.321]).

Comparing the pre- and post-Belt Cane video footage. Figure 1 shows the obvious visible difference in motor skills pre/post introduction of the Belt Cane. A paired samples t-test revealed that the pre-videos were, on average, shorter ($M=218.7$, $SD = 149.88$) than post videos ($M=1108.9$, $SD = 781.44$, $t(49) = -8.08$, $p<.05$). Two motor skills, Laying Down and Crawling were only observed in pre-videos. The children spent significantly more time Sitting in pre-videos ($M=99.94$, $SD = 149.28$) compared to Sitting in post-videos ($M=5.92$, $SD = 17.20$, $t(49) =4.43$, $p <.05$). The children spent the significantly more time Standing with Assistance in pre-videos ($M=45.66$, $SD = 66.18$) compared to Standing with Assistance in post-videos ($M=5.86$, $SD = 14.62$ $t(49) =4.22$, $p <.05$).

The children spent the significantly less time Standing Solo in pre-videos (M=9.94, SD = 24.38) compared to Standing Solo in post-videos (M=26.68, SD = 37.88, t(49) = -2.81, p <.05). The children spent the significantly less time Walking Solo in pre-videos (M=30.46, SD = 46.32) compared to Walking Solo in post-videos (M=86.68, SD = 95.70, t(49) = -4.29, p <.05). There was no difference in amount of time spent Walking with Assistance pre-video (M=29.50, SD = 71.08) and post-video (M=15.34, SD = 35.43, t=1.32, p >.05) or Running pre- (M=.52, SD = .38) or post- (M=4.80, SD = 2.84, t= -1.52, p >.05) videos.

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Discussion

In this study, we examined walking in children with an MVI/B using the pre/post B6OMSI scores and pre/post O&M professional evaluation (Ambrose-Zaken, 2022; Baughn, 2021). A further aim was to evaluate whether differences in walking were based on age, gender, or degree of visual impairment before and after introduction of the Belt Cane.

Prior to obtaining a Pediatric Belt Cane, children with an MVI/B between the ages of 11 and 60 months did not use mobility tools with any skill or frequency. Children with blindness-induced walking delays demonstrate a preference for handheld assistance, and when asked to walk without an assistive safety device, demonstrate slow walking, refuse to walk, or lower down to the floor to scoot or crawl. They were overexposed to unsafe mobility and had blindness-caused walking delays.

These same children increased the amount of walking time, irrespective of age, gender, or degree of visual impairment. These improved outcomes are consistent with prior studies of children before and after introduction of the Pediatric Belt Cane. It can be concluded that wearing an assistive safety device such as

a Pediatric Belt Cane significantly improved their walking skills and is a medical necessity to combat blindness-caused walking impairment.

At in-take, adults stated the children were not able to use their mobility tools (walkers, long canes) for safe mobility during recommended daily physical activity. Adults' most frequent response given to question why they tried the Belt Cane, was they hoped it might improve the child with an MVI/B's safety and confidence. Children who wore the Belt Cane consistently for at least eight weeks changed from passive, quiet, idle babies, to engaged, age-appropriate kids.

Circuit and solo walking. Observers noted that in pre-videos, those children who walked solo appeared to follow a predictable pattern. For example, they were observed standing next to a couch with their hands in contact with it, next they would walk for a few seconds to another stable object such as a table and hold on to it for a while and then return to the couch. They would repeat that pattern multiple times with slight variation. These children did not initiate engagement with others in their surroundings.

In post-videos, the duration of children's walking was significantly longer and more varied. They initiated engagement with others in their surroundings, enticing them to play chase and other games. The children's greater movement created more opportunities for success and difficulties. This caused the children to have great vocal outcomes, sometimes they became frustrated. Far too often, the solution the adults chose was to penalize them and remove their safety, causing them to become still and quiet again.

On the in-take form, adults stated the children's walking ability was environment specific, defined as the children seemed to walk better at home than elsewhere. The B6OMSI also characterized environment specific walking behaviors as developmentally appropriate for children with an MVI/B. In the walking assessment sequence, item "c. Takes 10 independent steps indoors" was listed as a skill to be achieved before item "d. Takes 10 independent steps outdoors."

This environment-specific distinction in walking skill is another example of blindness-caused walking impairment. Independent walking cannot be an environment-specific task for children who are not otherwise motor impaired. Walking is a basic function that children rely upon to engage in the world

across environments. The participants who consistently wore their Belt Canes for a full twelve weeks independently walked across indoor and outdoor environments more frequently and willingly.

Adult supervision and instruction improve outcomes. The observers noted that adult oversight was critical to children with an MVI/B's success using the Pediatric Belt Cane. Children with an MVI/B were not able to put the belt on or connect the cane frame independently. However, once adults attached the Belt Cane to the children, the children needed less direct assistance from adults for employing the tool. Instead, the adults spent their time watching and engaging the children in play activities.

All children benefited from the Belt Cane. Families and certified professionals who followed the Pediatric Belt Cane curriculum were more likely to use the Belt Cane most of the day and their children received the most benefit.

B6OMSI Walk First, Safety Later is Outdated Assessment and Instructional Practice. Prior to obtaining a Belt Cane, adults reported the children with an MVI/B as delayed in their motor skills. Professional observation indicated the children were more likely to be sitting down than demonstrating any other motor skill. Able-bodied children with an MVI/B silently sitting alone appear to be a common characteristic of blindness-caused walking delays.

Very few adults used handheld mobility tools with the children during the pre-videos. When the children with an MVI/B walked freely, they were unprotected and unable to avoid collisions. These findings are consistent with previous research on the motor skills and mobility tool usage of young learners with an MVI/B (Ambrose-Zaken, 2023, 2022).

These well-documented blindness-caused walking delays in children with an MVI/B are evidenced in the items of the B6OMSI, an instrument specifically designed to evaluate walking and cane skills in blind children aged zero to six years old. We found that the B6OMSI items and rating scale descriptions for the Motor Skills Scale deviated from the standards used to evaluate early childhood walking.

For example, evaluations of sighted children aged 18 months and older document the hours per day they walk (Bjornson, et. al., 2011). The B6OMSI motor skill scale asked us to count whether children were able to walk 5 or 10 steps with an assistive safety device.

During the pre/post interviews, parents completed the B6OMSI walking skill item sequence (a – f). Their reports showed they found the Belt Cane made a significant difference in their children's walking. Yet, their children's performance far exceeded the B6OMSI walking standard of five and ten independent steps. O&M evaluations reported when wearing the safety of the Pediatric Belt Cane, the more appropriate measure of these children was their walking time in units of hours each day. The findings of our study are consistent with multiple published studies showing that blindness-caused walking impairment can be reversed and prevented by providing these children with an assistive safety tool to use during their daily recommended physical activity hours (Ambrose-Zaken, 2022, Ambrose-Zaken, et a., 2019, Ambrose-Zaken, Chong, Enzenauer, 2024).

Implications for practice

Belt Canes are a medical necessity for infants with an MVI/B to walk. The degree of visual impairment is the basis to determine when mobility tools are a medical necessity for an infant. A child with a mobility visual impairment or blindness is at risk for blindness-related walking delays. The safety of an assistive safety device, like a Pediatric Belt Cane, is a medical necessity for infants with an MVI/B to walk.

Before children wore the Belt Cane, there were significant age differences in walking skills found. Three-year-old participants were walking more than the one-, two-, and four-year-old children. This is an uncharacteristic finding, as children above the age of 18 months typically engage in physical activity four to six hours a day. When children wore the Belt Cane, there was no distinguishable difference in the amount of solo walking within those age-groups. Children who feel safe to walk, walk more.

There can be no distinction in independent walking by location. A child with a visual impairment who is eighteen months or older is exhibiting blindness-caused walking impairment when unable to walk solo in an unfamiliar environment; and is frequently connected to surfaces in indoor environments instead of walking independently.

Encouraging toddlers to engage in unsafe mobility practices is inappropriate and causes motor skill delays. Overexposure to injury is the most obvious outcome of having an MVI/B, it is when walking

freely they are constantly at risk of colliding with obstacles. The lack of motor skill activity is another obvious blindness-caused walking impairment observed in the pre-videos. We found that when standing without an assistive safety device, they quietly found a way to hold on to furniture, or a hand, or sit down.

The results of this study suggest that unsafe mobility is the major contributor to blindness-caused walking delays in children with an MVI/B. Children with an MVI/B who cannot see the path ahead need constant protection, touch and sound information when standing, walking, and running beginning at the age of ten months. When adults included the use of a Pediatric Belt Cane with their children with an MVI/B, they reported significant positive improvement in every aspect of the children's motor skill activities. Children wearing Belt Canes caused them to walk the same amount as they had once sat idle in the pre-test.

Limitations and Suggestions for Future Research

Project participation. Of the fifty participants, twenty-six completed all project activities including submission of all twelve weeks of videos. The remaining twenty-four participants provided one to eleven weeks of videos. A one-way ANOVA showed that the children's motor skill improvement was not dependent on the number of weeks they participated. Children began showing motor skill improvement in Solo Standing [$F(9,14) = .411$, $p = 0.908$] and Solo Walking times [$F(9, 30) = .861$, $p = .569$.] from the start of wearing the Belt Cane.

However, a one-way ANOVA indicated that participants who left the study early had significantly lower B6OMSI score than those who completed the study. They specifically rated the post B6OMSI Walking scores [$F(5,28) = 6.997$, $p < 0.05$] and the Quality of Independent Walking scores [$F(5,28) = 3.617$, $p < 0.05$] lower based number of weeks participants shared videos. The greater the number of weeks of participation the more the adults felt their child's walking had improved.

Although all children were demonstrating improved outcomes according to professional metrics, early exiting adults either did not recognize that improvement, or did not consider these gains worth the additional effort required when using the Belt Cane. Perhaps the term 'babyproofing blind walking'

would help parents to better understand the nature of the Belt Cane's importance in keeping babies safe to walk.

References

Adolph, K. E., & Franchak, J. M. (2017). The development of motor behavior. *Wiley Interdisciplinary Reviews: Cognitive Science, 8*(1–2). doi:10.1002/wcs.1430

Ambrose-Zaken, G., Chong, P. Enzenauer, R., (2024). Comparative video gait analysis of assistance for children with cerebral visual impairment (CVI). Investigative Ophthalmology & Visual Science, 65(7):2579. https://iovs.arvojournals.org/article.aspx?articleid=2794668

Ambrose-Zaken, G., (2023) Beyond Hand's Reach: Haptic Feedback is Essential to Toddlers with Visual Impairment Achieving Independent Walking. *The Journal of Visual Impairment & Blindness, 117*(4), 278-291. https://doi.org/10.1177/0145482X231188728.

Ambrose-Zaken, G. V., FallahRad, M., Bernstein, H., Wall Emerson, R., & Bikson, M. (2019). Wearable Cane and App System for Improving Mobility in Toddlers/Pre-schoolers with Visual Impairment. *Frontiers in Education, 4*. doi.org/10.3389/feduc.2019.00044

Assaiante, C., Woollacott, M., & Amblard, B. (2000). Development of Postural Adjustment During Gait Initiation: Kinematic and EMG Analysis. *Journal of Motor Behavior, 32*(3), 211–226. https://doi.org/10.1080/00222890009601373

Baughn, S. (2021). Early Intervention Orientation and Mobility: A Delphi Study of the Content of the Birth to 6 Orientation and Mobility Skills Inventory (B6OMSI). *Journal of Visual Impairment & Blindness*, *115*(5), 361–371. https://doi.org/10.1177/0145482X211047626

Bjornson, K. F., Song, K., Zhou, C., Coleman, K., Myaing, M., & Robinson, S. L. (2011). Walking stride rate patterns in children and youth. *Pediatric physical therapy : the official publication of the Section on Pediatrics of the American Physical Therapy Association*, *23*(4), 354–363. https://doi.org/10.1097/PEP.0b013e3182352201

Bucci, M. P., Tringali, M., Trousson, C., Husson, I., Baud, O., & Biran, V. (2017). Spatial and temporal postural analysis in children born prematurely. *Gait & Posture*, *57*, 230–235. https://doi.org/10.1016/j.gaitpost.2017.06.023

Clark, J. E., & Phillips, S. J. (1993). A longitudinal study of intralimb coordination in the first year of independent walking: A dynamical systems analysis. *Child Development, 64*(4), 1143–1157.

Dusing, S. C., & Thorpe, D. E. (2007). A normative sample of temporal and spatial gait parameters in children using the GAITRite electronic walkway. *Gait Posture, 25*(1), 135–139.

Mallau, S., Vaugoyeau, M., & Assaiante, C. (2010). Postural strategies and sensory integration: no turning point between childhood and adolescence. *PloS one, 5*(9), e13078.

New Mexico School for the Blind (2021). Birth to 6 Orientation and Mobility Skills Inventory. https://www.nmsbvi.net/235010_2 (accessed 2/6/24).

Vieira, A. P. B., Carvalho, R. P., Barela, A. M. F., & Barela, J. A. (2019). Infants' Age and Walking Experience Shapes Perception-Action Coupling When Crossing Obstacles. *Perceptual and Motor Skills*, *126*(2), 185–201. https://doi.org/10.1177/0031512518820791

Table 1

Demographic characteristics of all in-take forms (N=124) and the those included in the analyses (N=50)

Status	Blind	MVI	DB	NR
N=124	n=49 Male n = 29 (59%) Female n = 20 (41%) Mean age 34 months (SD=19.89; range 11-99) Motor Imp. n=6	n=66 Male N = 38 (42%) Female n = 28 (58%) Mean age 44 months (SD=32.47; range 13-154) Motor Imp. N=7	n=7 Male n = 3 (43%) Female n = 4 (57%) Mean age 38 months (SD=12.28; range 16-53) Motor Imp. N=1	n=2 Male n = 1 (50%) Female n = 1 (50%) Mean age 44 months (SD=32.47; range 13-154) Motor Imp. N=0
N = 50	n=26 Male n = 16 (62%) Female n = 10 (38%) Mean age 25 months (SD=11.03; range 11-52)	n=22 Male n = 38 (42%) Female n = 28 (58%) Mean age 26 months (SD=10.20; range 14-44)	n=2 Male n = 1 (50%) Female n = 1 (507%) Mean age 40 months (SD=9.19; range 34-47)	

Table 2

Summary of the analyses, and the hypothesized directions to test the efficacy of providing safe mobility through wearing a Pediatric Belt Cane to achieve children with a MVI/B walking goals

Hypothesis	Groups/participants used to test the hypothesis	Statistical test used
1. Children's age, gender, degree of visual impairment will have no difference on motor skills prior to obtaining a Belt Cane.	B6OMSI scores and video data of motor skill activities from 50 children with a MVI/B before introduction of the Belt Cane: Age one (n= 22), two (n=10), three (n=13), four (n=5) boy (n=30), girl (n=20); blind (n=26), MVI (n=24), DB (n=2).	ANOVA 95% confidence intervals
2. Children's age, gender, degree of visual impairment will have no difference on motor skills after obtaining a Belt Cane.	B6OMSI scores and video data of motor skill activities from 50 children with a MVI/B after introduction of the Belt Cane: Age one (n= 22), two (n=10), three (n=13), four (n=5) boy (n=30), girl (n=20); blind (n=26), MVI (n=24), DB (n=2).	ANOVA 95% confidence intervals
3. Children with a MVI/B will sit less and walk more after introduction of the Pediatric Belt Cane.	B6OMSI scores and video data of motor skill activities from 50 children with a MVI/B before and after introduction of the Belt Cane	Paired *t*-test Two-sided p.
4. A child's ability to reach and hold objects is not a predictor of the child's ability to independently use long canes for safe mobility.	B6OMSI scores from 50 children with a MVI/B before introduction of the Belt Cane	Pearson's r correlation between the ability to reach and hold objects and cane skills.

Figure 1

Average time in seconds engaged in specific motor skills during pre-and final-Belt Cane video (n=50)