

## Differentiating Between Idiopathic Toe Walking and Cerebral Palsy: A Systematic Review

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*Background:* Toe walking is defined as the absence or inability to obtain heel strike during the initial contact and stance phases of the gait cycle<sup>1</sup>. Many developing toddlers tend to walk with a wide base of support, externally rotated hips, flexed knees and plantarflexed feet<sup>2</sup>. Toe walking is considered a typical part of a developing gait pattern but begins to be considered abnormal past the age of three years<sup>3</sup>. Toe walking can occur with various diagnoses, such as Cerebral Palsy, Autism Spectrum Disorder, Muscular Dystrophy or Spina Bifida<sup>4</sup>. However, when no other orthopedic, musculoskeletal, or neurological condition that can cause this gait pattern can be identified, a diagnosis of Idiopathic Toe Walking (ITW) is given. The purpose of this systematic review is to provide a comparison of the gait characteristics and muscle firing patterns in children with a diagnosis of ITW and Mild Spastic Diplegia (MSD), a type of Cerebral Palsy. Mild Spastic Diplegia is a neurological condition that is characterized by muscle weakness, changes in muscle tone, and impaired selective motor control. The lower extremities are more affected, which leads to deficits in functional mobility. MSD can be often confused with ITW due to similarities in gait patterns. The authors identified 5 studies that compared gait patterns and muscle firing patterns in children with MSD and ITW.

*Methods:* The authors searched four databases between the dates of September 13-28, 2016, which included PubMed, CINAHL, SPORTDiscus, and Medline. The following search terms were utilized for each database: (Idiopathic Toe Walking and Cerebral Palsy), (Idiopathic Toe Walking and Spastic Diplegia), (Habitual Toe Walking and Cerebral Palsy), and (Habitual Toe Walking and Spastic Diplegia). Articles were included if they met the following inclusion criteria: a diagnosis of ITW or MSD, including subjects between the ages of 3-18 in ITW group and 2-18 in MSD group, and did not include subjects with comorbid conditions previously identified to cause toe walking. Articles were excluded if they primarily discussed physical therapy intervention for ITW or primarily discussed medical intervention for ITW. After thorough review of the research, five articles remained that met our inclusion and exclusion criteria.

*Results:* Two of the studies looked at kinematic variables in children with ITW and MSD. Both authors concluded that knee kinematics were normal in the ITW group<sup>3,5</sup>. However, children with MSD presented with increased knee flexion angles, presumably due to increased hamstring tone. Children with ITW showed increased plantarflexion at initial contact and active muscle contraction of their gastrocnemius muscles during swing phase, causing them to strike in an equinus position<sup>3</sup>. This differed from the pattern of children with MSD. The children with MSD also demonstrated increased plantarflexion at initial contact, but this was because of an increase in knee flexion, which changed the position of the foot. This did not allow the child to contact the ground with the mid or rearfoot<sup>3,5</sup>. There were three studies that utilized electromyography to look at differences in muscle timing between children with ITW, MSD, and typically developing children. All articles agree that there were no significant differences in muscle firing between ITW and MSD during gait<sup>6,7,8</sup>. Children with MSD demonstrate an obligatory extensor synergy, which causes coactivation of the quadriceps and gastrocnemius muscles during isometric knee extension<sup>7,8</sup>. This is not seen in children with ITW and children without neurological deficits. This is

clinically significant because it may allow physical therapists to differentiate between children with ITW and MSD using surface electromyography or palpation during resisted knee extension.

*Discussion and Conclusions:* Because ITW is a diagnosis of exclusion, there are limited tests and measures that clinicians can utilize. Clinically, the results of this systematic review can be used to help differentiate between a diagnosis of ITW and MSD. Clinicians can perform a simple examination, including gait analysis and electromyography or palpation during resisted contraction, to help differentiate between ITW and MSD. It is important for clinicians to be able to make this differentiation, because the two conditions are treated differently. Early detection of the correct cause for toe walking can increase access to both physical therapy and medical interventions, which may greatly improve the child's prognosis.

*References:*

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