

# Tai Chi as an Exercise Intervention in Children with Cerebral Palsy

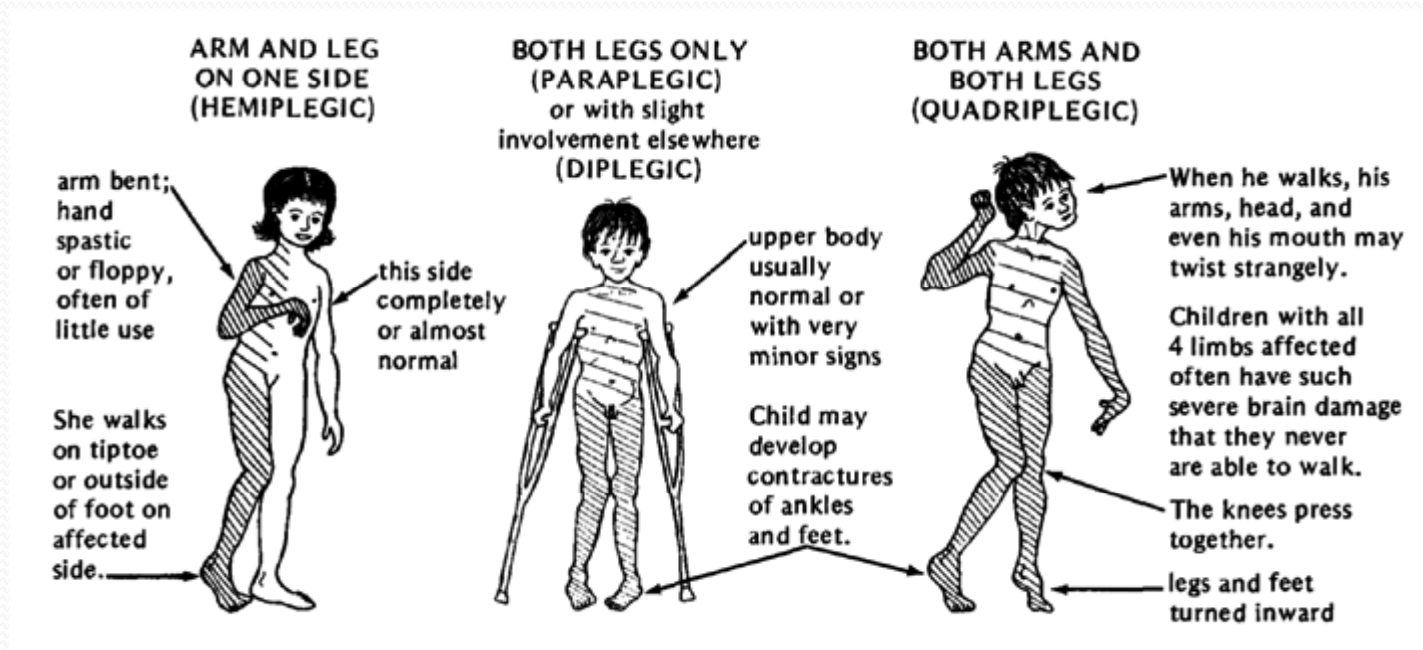
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# What is Cerebral Palsy?

- Non-progressive neurodevelopmental condition
- Signs:
  - Spasticity
  - Ataxia
  - Muscle rigidity
  - Athetosis
  - Tremor

# Distribution Among Limbs





# Why study cerebral palsy?

- 3.6 per 1000 children have cerebral palsy (CP)<sup>1</sup>
- CDC estimated lifetime costs of CP \$921, 000
- Costs Factors<sup>2</sup>
  - Healthcare => physical therapy
  - Productivity => parents leaving job to take care of child or adult with CP has to leave labor market or was unable to begin working
  - Social => education, assistive device
- Focus on improving gait

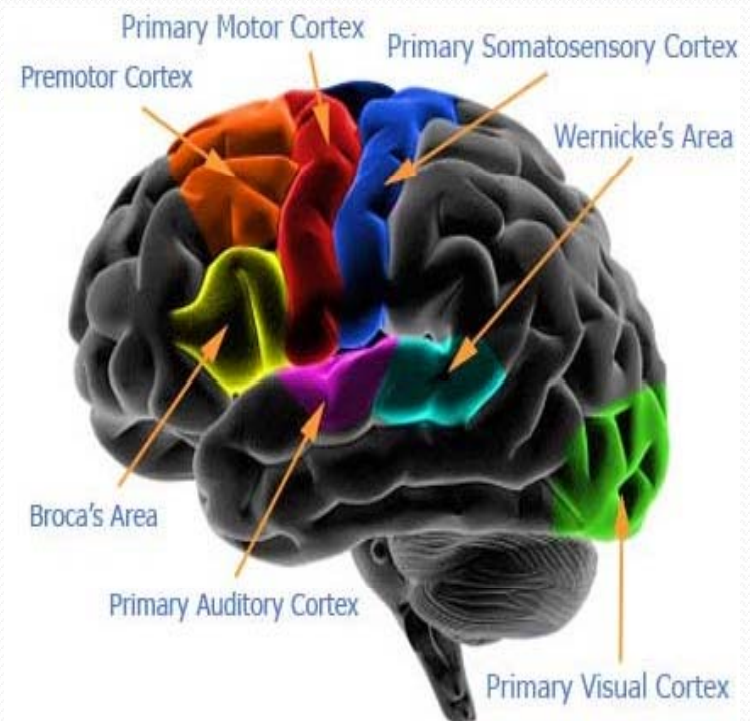



# Classifying cerebral palsy

- Gross Motor Functional Classification System (GMFCS)<sup>3</sup>
- Categorizes children by their level of motor function
  - Lay and roll, sit, crawl and kneel, stand, walk, run jump
  - Predict future motor function
- Five Levels
  - Level I => walks without limitation
  - Level II => walks with limitations
  - Level III => walks using a hand-held mobility device
  - Level IV => Manual wheel chair
  - Level V => Require extensive assisted technology and physical assistance

# Physical Impairments

- Stiff knee gait during swing combined with knee flexion during stance => crouch gait<sup>4</sup>
- Decrease muscle force<sup>5</sup>
- Decrease energy level<sup>6</sup>
- Decrease joint position sense<sup>7</sup>



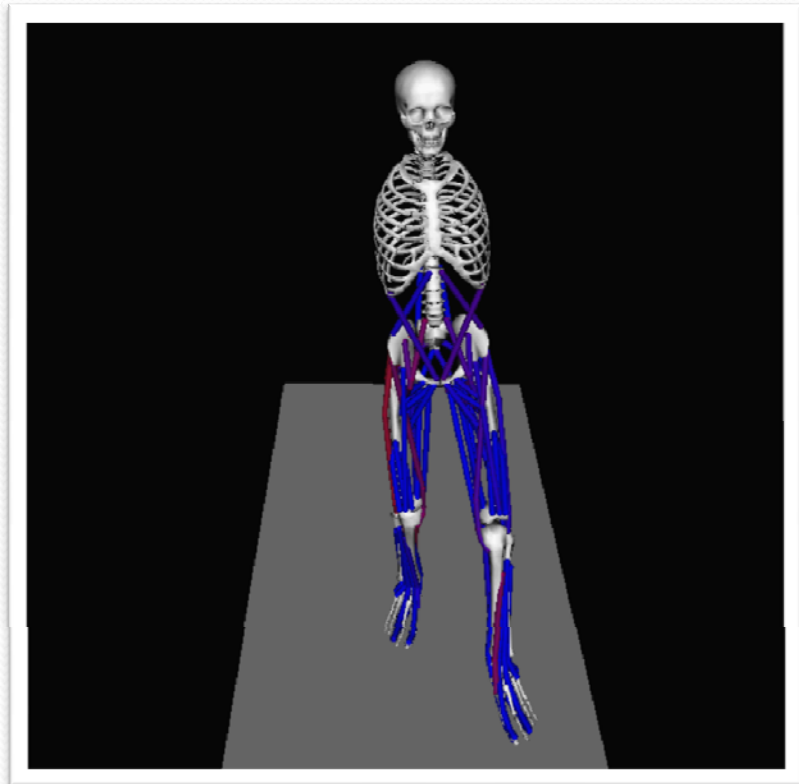


# Where are we now in treating people with cerebral palsy?

- Non-invasive treatment options:
  - Strength training<sup>8</sup>
  - Weight assisted treadmill walking<sup>9</sup>
  - Get out and play<sup>10</sup>

# Strength Training

- Purpose => improve walking
- function and lower extremity alignment<sup>8</sup>
  - Decrease crouch
  - Hip internal rotation
- Review<sup>11</sup>
  - Ambulatory spastic diplegic
  - children with CP experienced
  - no changes in:
    - Strength
    - Walking speed
    - Gross motor function (ADL's)
- Explanation => large deficits in voluntary muscle activation
- Voluntary contraction may not produce
- sufficient force to increase strength<sup>6</sup>





# Weight Supported Treadmill Training vs. Over Ground Walking<sup>9</sup>

- Children with CP in Level III or IV
- 9 weeks 2x per week
  - Treadmill group given cues on phases of gait cycle
- No improvement between groups
  - Ten-meter walk test
  - Ten-minute walk test
- Kinematics not measured
- Future research =>combine strength and walking protocols



# Tai Chi as a Possible Treatment?

- Explore effectiveness of other treatment programs
- Example: Previous study examined the effects of Tai Chi on balance and mobility in people with Parkinson disease<sup>12</sup>
  - Methods
    - 33 participants at least 40 years of age
    - Tai Chi form - Chen Manching Yang Short Style
      - 20 lessons within 13 weeks
  - Results
    - Improvements 6-Minute Walk
    - Berg Score

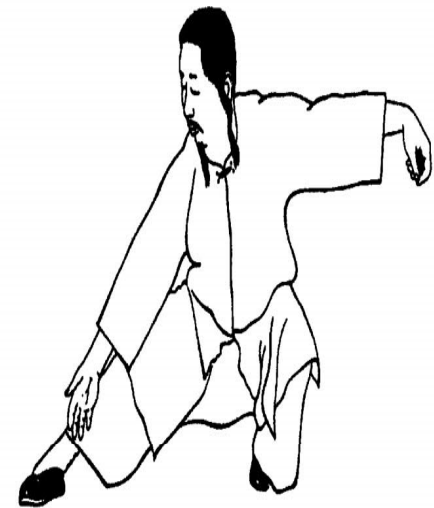


# What is Tai Chi Chuan?

- Slow-motion exercise for relaxation, health, and self defense<sup>14</sup>
- Focuses on continuous slow movement and breathing
- Became popular worldwide for health benefits
  - Improve balance<sup>14</sup>, flexibility<sup>14</sup>, and muscle strength
  - Reduce stress<sup>14</sup>
  - Lower blood pressure<sup>15</sup>
  - Increase energy, endurance, and agility

# Why use Tai chi as a treatment option?

- Suitable for all: young or old, male or female, strong or weak
- Safe
  - No equipment necessary
- Requires very little space for maneuvering

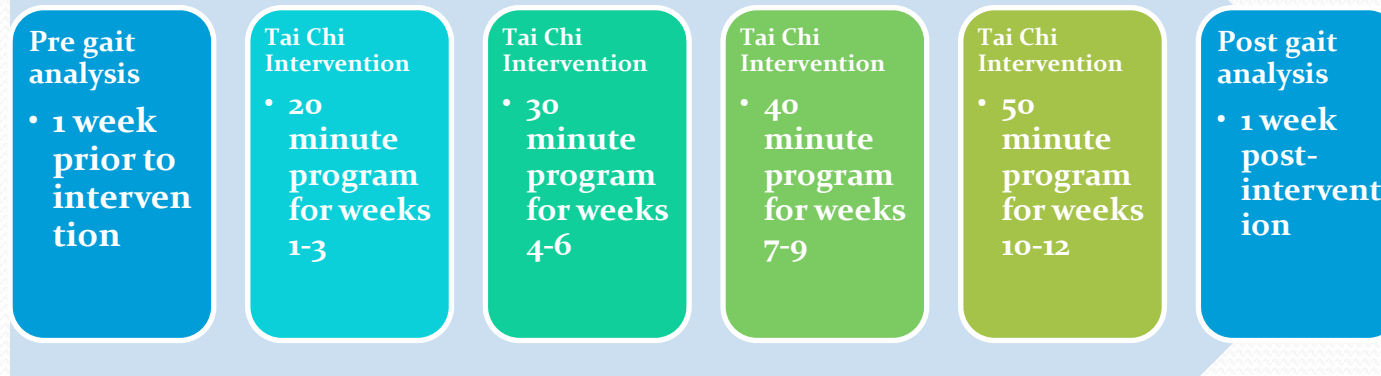


# Our Proposal

- Tai Chi intervention in children with cerebral palsy
  - Criteria
    - 30 participants ages 5-13
    - GMFCS Level I Spastic hemiplegia and diplegia
    - 30 age-matched controls with cerebral palsy
  - Yang style short form
    - 5 easily comprehensible postures<sup>13</sup>



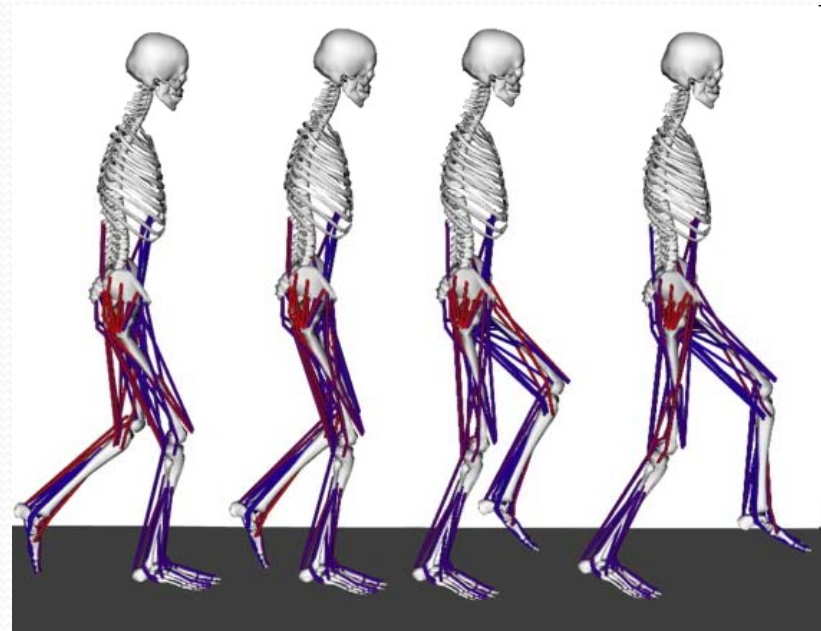
# Timeline



- 12 week intervention period
  - 2 training periods per week
  - 10-15 minute warm up session prior to Tai Chi exercise

# Pre and Post Gait Analysis

- Equipment
  - Force Plates
  - Motion Capture System
- Tests/Measurements<sup>12</sup>
  - Berg Balance Scale
  - Timed up and go test
  - 10 Minute Walk Test





# References

1. Damiano, D.L., Alter, K.E., Chambers, H., 2009. New clinical and research trends in lower extremity management for ambulatory children with cerebral palsy. *Physical Medicine & Rehabilitation for Clinicians North America* 20(3), 469-491.
2. Kruse, M., Michelson, M.M., Flachs, E.M., Bronnum-Hansen, H., Madsen, M., Uldall, P., 2008. Lifetime costs of cerebral palsy. *Developmental Medicine & Child Neurology* 51, 622-628.
3. Palisano, R., Rosenbaum, P., Walter, S., Russel, D., Wood, E., Galuppi, B., 1997. Developmental and reliability of a system to classify gross motor function in children with . *Developmental Medicine & Child Neurology* 39, 214-223.
4. Krogt, van Der, M.M., Bregman, D.J.J., Wisse, M., Doorenbosch, C.A.M., Haplaar, J., Collins, S.H., 2010. How crouch gait can dynamically induce stiff-knee gait. *Annals of Biomedical Engineering* 38(4), 1593-1606.
5. Kerr, C., Parkes, K., Stevenson, M., Cosgrove, A.P., McDowell, B.C., 2008. Energy efficiency in gait, activity, participation, and health status in children with . *Developmental Medicine & Child Neurology* 50, 204-210.
6. Stackhouse, S.K., Binder-Macleod, S.A., Lee, S.C.K., 2005. Voluntary muscle activation, contractile properties, and fatigability in children with and without . *Muscle & Nerve* 31, 594-601.
7. Wingert, J.R., Burton, H.B., Sinclair, R.J., Brunstrom, J.E., and Damiano D.L., 2009. Joint-position sense and kinesthesia in . *Archives of Physical Medicine and Rehabilitation* 90, 447-453.
8. Damiano, D.L., Arnold, A.S., Steele, K.M., Delp, S.L., 2010. Can strength training predictably improve gait kinematics? A pilot study on the effects of hip and knee extensor strengthening on lower extremity alignment in . *Physical Therapy* 90(2), 269-279.
9. Willoughby K.L., Dodd, K.J., Shields, N., Foley, S., 2010. Efficacy of partial body weight-supported treadmill training compared with overground walking practice for children with cerebral palsy: a randomized control trail. *Archives of Physical Medicine and Rehabilitation* 91, 333-339.





# References

10. Damiano, D.L., 2006. Activity, activity, activity: rethinking our physical therapy approach to cerebral palsy. *Physical Therapy* 86(11), 1534-1540.
11. Scianni, A., Butler, J.M., Ada, L., and Teixeira-Salmela, L.F., 2009. Muscle strengthening is not effective in children and adolescents with: a systematic review. *Australian Journal of Physiotherapy* 55, 81-87.
12. Hackney, M.E., Earhart, G.M., 2008. Tai chi improves balance and mobility in people with parkinson's disease. *Gait & Posture* 28(3), 456-460.
13. McGibbon, C.A., Krebs, D.E., Parker, S.W., Scarborough, D.M., Wayne, P.M., Wolf, S.L., 2005. Tai Chi and vestibular rehabilitation improve vestibulopathic gait via different neuromuscular mechanisms: Preliminary report. *BMC Neurology* 5.
14. Wang, C., 2004. The effect of Tai Chi on health outcomes in patients with chronic conditions. *Archives of Internal Medicine* 164, 493-501.
15. Chen, William. Body Mechanics of Tai Chi Chuan. New York, NY: Chen, 1973.