Crouch Gait in Children With Spastic Cerebral Palsy

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BME 473
Outline

• Cerebral Palsy Overview
• Methods of Treatment
  • Surgery
  • Strength Training
  • Orthotics
• Proposed Research
What is Cerebral Palsy?

• Loss or impairment of motor function caused by brain damage
  • Damage due to injury or abnormal development of brain
  • Can occur before, during, or immediately after birth

• Affects
  • Body movement
  • Muscle control, coordination, tone
  • Reflexes
  • Posture
  • Balance
  • Motor skills
  • Oral motor functioning

https://www.youtube.com/watch?v=Sv7T5ADXqyM
Cerebral Palsy Statistics

Cerebral Palsy Statistics in U.S.A.

- About 764,000 children and adults have c.p.
- About 500,000 children under 18 have c.p.
- Around 1,200–1,500 pre-school aged children are diagnosed each year with c.p.
- Around 8,000–10,000 babies and infants are diagnosed per year with c.p.
- About 2–3 children out of 1,000 have c.p.
- About 10,000 babies born each year will develop c.p.

Source of information: cerebralpalsy.org

EnabledKids.ca
Types of Cerebral Palsy

- Spastic (pyramidal)
  - Increased muscle tone throughout body
  - Accounts for 70%-80% of all CP cases

- Non-spastic (extrapyramidal)
  - Ataxic (5% of all CP cases)
  - Dyskinetic (15% of all CP cases)
  - Mixed
Spastic Cerebral Palsy
Biomechanics of Crouch Gait

Knee Extension Angle [°]

Ankle Dorsiflexion Angle [°]

Knee Flexion Torque [Nm]

Ankle Plantarflexion Torque [Nm]
Common Treatments

• Botox injections
  • Risks: Botulism

• Physical therapy
  • Soft tissue mobilization
  • Joint mobilization
  • Stretching
  • Endurance exercises
Surgery Treatment

• “Birthday surgery” approach
• Replaced by Single-event Multilevel Surgeries
  • Rectus femoris
  • Hamstrings
  • Gastrocnemius
Strength Training

• Resistance training
• Increase strength of weak muscles that contribute to crouch gait
• Damiano et. al
  • 6 week program
  • 3 days per week
  • Measure max isometric force quadriceps femoris can produce, child lifts ankle weights that are 65% of this load
• Results: Force in quads increased by 51 N-63 N; flexion decreased by 1°-9°
Orthotics

- Braces
  - Foot
  - Knee
  - Spinal
  - AFO
  - THKAFO

- Matthias et. al

- Focus in Ankle-Foot
  - Pro’s
    - Swing, tendons, fascicles
  - Con’s
    - Muscle thickness, fascicles
Proposed Study

• Benefits of SEMLS shown to degrade over 10 year period
  • Ōunpuu et. al: Range of motion gains in knee and ankle lost over 10 year span

• Will knee extension improvement following surgery be better preserved when combined with other rehabilitation strategies?
Proposed Study

• 10 yrs

• Study groups
  • Group 1: Control
  • Group 2: Orthotics
  • Group 3: Strength training
  • Group 4: Strength training + orthotics

• Start with ~250 participants
  • Ages: 7-12 yrs of age
  • Must have had a SEMLS within the last year

• Monitor knee extension angles with motion capture technology in a motion lab 3 times a year
Proposed Study: Orthotics Group

• This group will attend physical therapy prescribed post surgery.
• The child will wear the ankle-foot orthotic everyday
  • Exceptions for when bedridden
Proposed Study: Strength Training Group

• Damiano et. al: Studies included SEMLS children; these children saw improvements

• Child will perform exercises 1 time per week for 10 years
  • Warm up: Lower extremity stretching/brief walk
  • Child sits up right in chair with hip at 90° flexion
  • Knee in 90° of flexion, ankle weights attached
  • Child fully extends knee, returns knee to start position
  • 4 sets, 5 repetitions each leg; rest a minute between sets

• Weights will start out at 65% max isometric strength of quadriceps femoris, will be adjusted monthly
Proposed Study: Strength Training Group
Proposed Study: Expected Results

• Group 1
  • Muscle degradation
  • Gait regression

• Group 2
  • Muscle atrophy
  • Gait improvement

• Group 3
  • Gait improvement

• Group 4
  • Gait improvement
  • Muscle preservation
References


• MyChild. 12 October, 2015. cerebralpalsy.org

Thank you!