Tuning Hypotonia Through PlasmaCar Play

presented by
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I. Defining Hypotonia

II. Previous Interventions

III. Proposed Research
What is hypotonia?

An individual who exhibits:
- weakness
- low muscle tone
- abnormal reflexes
- sensory and motor problems
Characteristic Hypotonic Positions in Infants

- Head lag
- Shoulder slippage

A. “Slip through”
Characteristic Hypotonic Positions in Infants

- Head sinks back
- Low muscle tone in shoulders, back, neck

B. “Pull to sit”
Characteristic Hypotonic Positions in Infants

- Extensive mobility in shoulder joint

C. “Scarf sign”
Characteristic Hypotonic Positions in Infants

C. "U" position

- Head and appendages respond to gravity
Defining **Hypotonia**

“
The lack of **muscle tone**, or resistance to passive movement, around a given joint.
”
Defining *Hypotonia*

“

The lack of *muscle tone* or resistance to passive movement around a given joint.

”

*muscle tone* = resistance to stretch during inactivity
Production of Movement (forward dynamics)

Root of the cause?
Hypotonia is not a muscle disorder but rather a trait of many diseases.
Hypotonia is a common symptom of...

- Congenital or Sensory Neuropathies
- Congenital Myopathies
- Neuromuscular Junction Disorders
- Muscular Dystrophies
- Metabolic and Multisystem Diseases
- Anterior Horn Cell Disorders
Production of Movement (forward dynamics)

- Sensory Organs
- Musculotendon Dynamics
- Musculoskeletal Geometry
- Multi-Joint Dynamics
- Observed Movement

- EMGs
- Forces
- Moments
- Accelerations
- Velocities, Angles

Lengths, Velocities

Neural Command
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31% Genetic/Chromosomal Syndrome

13% Down syndrome
Down Syndrome

By the numbers

• 1 in 800 newborns

• 250,000+ individuals in the U.S.

• 50% less muscle tone and strength in comparison to healthy individuals of same age
Down Syndrome

**By the numbers**

- 1 in 800 newborns
- 250,000+ individuals in the U.S.
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**Muscle Characteristics**

- hypotonia
- reduced strength
- delayed motor skills
  - gross
  - fine
Down Syndrome

By the numbers

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Muscle Characteristics

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*Prevalent in adulthood
Previous Interventions

Physical Therapy

Postural Tone (Axial)

Phasic Tone (Appendicular)

Better control over slow and fast twitch muscles for improved tone and strength in the upper limbs.
Promoting Physical Activity through Wii Games
Assisted Cycling as a means to Improve Tone and Strength
In Action
How it Works

- Inertia
- Gravity
- Moment -> Torque

\[ \theta_L = \theta_R = 36.7^\circ \]
\[ \theta_L = 0^\circ, \theta_R = 73.4^\circ \]
\[ \theta_L = 73.4^\circ, \theta_R = 0^\circ \]
Biomechanics of PlasmaCar

- Influences development of muscle tone and control
  - Shoulder circumduction
    - Primarily flexed position
      1. Abduction + flexion (hand moving to top)
      2. Adduction + extension (hand moving to bottom)
Biomechanics of PlasmaCar

- Wrist flexion/extension
  - Neutral position
    1. Flexion (hand moving to top)
    2. Extension (hand moving to bottom)
Improving Design

• Wheels
  • Molded plastic → Polyurethane
    • Increased grip/reduce slip and wear
    • Can drive on asphalt
  • Adjustable diameter/thickness
    • Increase applicable torque
    • Increase potential physical gains

• Steering wheel
  • Padded grip
  • Adjustable diameter
    • Increases shoulder muscle range of motion
    • Increases potential physical gains
Proposed Study

Three groups of ten DS individuals (n=30) with ~1-year study

Group 1: No physical therapy regimen (control)

Group 2: Traditional physical therapy (PT)

Group 3: Traditional PT combined with improved PlasmaCar

Measurements and Comparisons

Daily physical activity log (including estimated time spent in PT and on PlasmaCar)

Pulse oximeter readings once a week recorded before, during, after exercise

BMI and body fat percentage clinically measured once a month

Compare all assessments to baseline (muscle tone and strength)
References


Image

1. https://casterconnection.files.wordpress.com/2011/03/cc6wheel-no-background.png

Questions