The effects of localised cooling or warming on neuromuscular function in people with Spastic Paraparesis (pwSP)

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Research Team
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Spastic Paraparesis

Type I uncomplicated

- Bilateral LL weakness
- Hyperreflexia + spasticity
- Extensor plantar responses
- Impaired vibratory sense
- Urinary Urgency
What people with SP say about their walking in the cold:

“seems to take longer for messages to get from my brain to my feet”

“I fall more, my legs are very stiff and my feet are like stone”

“stiff as a gate, feel it more in my ankles and lower legs”

“When its cold legs stiffen up its difficult to walk or move them I feel like a tin soldier”
Possible neuromuscular effects of heat and cold

Peripheral or central nerve conduction
  Amount of Force - MVC
  Rate of Force Generation
  Passive stiffness
  Stretch reflex mediated stiffness - spasticity

Functional walking ability
Aim of study

“to investigate the impact of temperature changes (cooling and warming) on neuromuscular function (muscle stiffness, muscle strength, peripheral and central nerve conduction) and walking ability in pwSP and healthy controls”
Methods

Participants

N=41
pwSP=22
Controls=19

Baseline measures

30 mins localised external cooling 7°C / warming 43°C
Most affected leg

Post intervention measures
Measures

Clinical
- 10m timed walk
- Foot taps

Physiological
- Core/ skin/ room temperature
- Central nerve conduction
- Peripheral nerve conduction (tibial nerve)
- Stiffness (passive and stretch reflex mediated)
- Maximal voluntary contraction and rate of rise of force (dorsiflexion and plantarflexion)
Stiffness – Passive and stretch reflex mediated

Slow Stretch

Fast Stretch

\[
\text{Stiffness} = \frac{\text{Change in Torque}}{\text{Change in position}}
\]
Force – MVC and rate of rise of force

Torque

Tibialis Anterior EMG

Time (s)
Results – demographics

<table>
<thead>
<tr>
<th></th>
<th>pwHSP (22)</th>
<th>Control (18)</th>
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<tbody>
<tr>
<td>Age (yrs)</td>
<td>55(±13)</td>
<td>48.2(±10.4)</td>
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<tr>
<td>BMI</td>
<td>25.3(±3.7)</td>
<td>24.7(±3.1)</td>
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<tr>
<td>Male / female</td>
<td>11/11</td>
<td>11/8</td>
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Genetic Diagnosis – 17 people had family history
8 people had a genetic diagnosis SPG4 x 6, SPG3A x 1, SPG10 x 1

Change in skin temperature

↑9.8 (±0.25)
↓13.1 (±2.2)
Results: Walking time

Greater increase in walking time with cooling in pwSP
Results: Foot tap time

Greater increase in tap time with cooling in pwSP
Results: Peripheral and Central Conduction

Peripheral Conduction Velocity

Cooling decreases and warming increases conduction velocity.

Central Conduction Time

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<tr>
<td>Threshold (%)</td>
<td>60(13.9)</td>
<td>51(12.2)</td>
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<tr>
<td>Conduction Time (ms)</td>
<td>21.21(6)</td>
<td>17.66(5.7)</td>
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No effect of Temperature in either group.
Results: Stiffness - passive and stretch reflex mediated

Greater Decrease in stiffness with warming in pwSP
Results: Force Production

Reduction in MVC and rate of force more marked in controls with cooling
Conclusions

**Cooling**

**Negative Effects**
- Slower walking
- Slower foot taps
- Slower rate of force generation
  - Lower maximal force
- Small increase in spasticity
- Peripheral Nerve signals are slower

**Warming**

**Positive Effects**
- Faster walking
- Faster foot taps
- Faster rate of force generation
- Decrease in spasticity and stretch reflex mediated stiffness
Way forward – working with pwSP

Warming ± Insulation
The Research Team/ Acknowledgements

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Questions

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Come and see us at Stand 50!!