Clinical Tools For Assessment of Selective Voluntary Motor Control In Patients with Spastic Cerebral Palsy

SCALE: Selective Control Assessment of the Lower Extremity & TASC: Test of Arm Selective Control

Presenters

SCALE
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Spastic Cerebral Palsy Multiple Impairments
Selective Voluntary Motor Control (SVMC)

The ability to perform isolated joint movements upon request, without using mass flexor/extensor patterns and without undesired movement at other joints, such as mirroring

Overview of SVMC

- Results from damage to the corticospinal tracts – pathways for voluntary movement responsible for fine control
- Important for treatment planning and surgical decision making
- While only assessed in patients with spastic CP, it has a separate mechanism from spasticity
- Used as screening for selective posterior rhizotomy

Corticospinal Tracts

- Commonly injured in CP
- White matter damage of prematurity (e.g. PVL)
- Responsible for voluntary movement
  - Force
  - Speed
  - Timing
  - Pattern

\[\text{Diagram of corticospinal tracts showing face, arm, leg, and ankle sectors.}\]
Tools

• Lower extremity – SCALE
  - Developed at UCLA (Fowler et al 2009)
  - Hip, knee, ankle, subtalar joint, toes
• Upper extremity – TASC
  - Developed at Northwestern University
  - Shoulder, elbow, forearm, wrist, fingers, thumb
• Both ask patient to perform selective movement task
• Similar administration and scoring

Scoring

• SVMC at each joint is graded as:
  - Normal = 2 points
  - Unable/Absent = 0 points
  - Impaired = anything else = 1 point
• SCALE
  - 5 joints for a maximum of 10 points per limb
• TASC
  - 8 movement patterns for a maximum of 16 points per limb

SCALE Validity and Reliability

• Content validity
  14 expert clinicians
  Rated content, administration and grading
  Mean agreement 91.9%
  Recommendations incorporated into final tool
• Construct validity
• Interrater reliability
SCALE: Construct Validity

\[ r = -0.83 \]

\[ p < 0.001 \]

SCALE Interrater Reliability

<table>
<thead>
<tr>
<th>Group</th>
<th>Limb</th>
<th>ICC</th>
<th>95% CIs</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Left</td>
<td>0.88</td>
<td>0.69, 0.97</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>A</td>
<td>Right</td>
<td>0.89</td>
<td>0.72, 0.97</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>B</td>
<td>Left</td>
<td>0.90</td>
<td>0.77, 0.97</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>B</td>
<td>Right</td>
<td>0.91</td>
<td>0.78, 0.97</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

SCALE Validity and Reliability

Balzer et al (Dev Med Child Neurol 2016)

- German translation of SCALE
- 38 participants
- Validity
  - Similar results to UCLA using GMFCS
- Inter-rater reliability
  - ICC >.9; p <.001
- Intra-rater reliability (video)
  - ICC >.9; p <.001
Overview of SCALE

- Patient is able to follow directions
  - Minimum age typically 4 years
- Hip, knee, ankle, subtalar and toe motion
- Non-synergistic movement task
- Check available passive ROM
- Move within 3 second verbal count
- Move ONLY the joint being tested
- Grade best performance

Scoring System

Example of scores for a child with spastic diplegic CP

<table>
<thead>
<tr>
<th>Grade</th>
<th>Left</th>
<th>Right</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>✅</td>
<td>✅</td>
</tr>
<tr>
<td>Impaired</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impaired</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Maximum score per each lower limb = 10

Grading

- Normal
  - Completes isolated movement within 3 seconds
- Unable
  - Does not move requested joint or
  - Cannot perform movement out of synergy
- Impaired
  - Less than 50% available motion
  - Slower than 3 second verbal count
  - Mirror movements of contralateral limb
  - Motion at other joints
  - Movement occurs only in one direction
Grading Guidelines

- Only grade what you observe – no assumptions
- If contracture is present
  - Grade movement that you see, not palpate
  - Note contracture in descriptor section
  - Area for comments

Hip

Starting position

“flex”  “extend”  “flex”

Knee

Starting position

“extend”  “flex”  “extend”
Ankle

“Starting position”

“move foot up”  “down”  “up”

Subtalar Joint

Starting position

“in”  “out”  “in”

Toes

Starting position

“flex”  “extend”  “flex”
**Administration and Grading Guidelines**

- **Hip**
  - Tight hamstrings restricted ROM
  - Can use hip extension with knee flexed
- **Knee**
  - Allowed to lean back on hands
  - Watch for trunk movement
- **Ankle**
  - Can flex knee to 20°
  - Must observe at least 15° arc of motion
- **Subtalar**
  - Need active eversion
- **Toes**
  - Motion at all five toes

**Resisted Extensor Synergy**

**Resisted Flexor Synergy**

("Confusion Test")
Descriptors for Impaired Grade

- Mirrors motion on opposite limb
- Motion slower than 3 sec verbal count
- Moves one direction only
- Movement of other joints
  - Motion less than 50% of range
  - Contractures/spasticity interfere, knee, ankle
  - Ankle: inverts/everts, not pure dorsiflexion
  - Ankle: primarily moves toes

Clinical Examples: Videos

- Each joint
- Each grade
- Patient example

TASC
Administration and Scoring

Kristin J. Krosschell, PT, DPT, MA, PCS
SCALE: Research and Clinical Decision Making
Loretta Staudt, MS, PT

- Research
  - Proximal to distal impairment
  - SVMC and gait
  - Force production
  - Mirror movements

- Clinical decision making
  - Selective posterior rhizotomy
  - Hamstring lengthening
  - Exercise design

Research in UE SVMC and Relationship to TASC
Theresa Sukal-Moulton, PT, DPT, PhD
Bibliography


Sukal-Moulton T, Clancy T, Zhang, L, Gaebler-Spira D. Clinical application of a robotic ankle training program for cerebral palsy compared to the research laboratory application: Does it translate to practice? *Arch Phys Med Rehabil* 2014; **95**:1433-40.


