Neurodynamic Testing and Neural Mobilization

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Disclosures

• The authors have no conflicts of interest to report
Objectives

• Determine when neurodynamic restrictions may be present.
• Evaluate neurodynamics through neurodynamic testing and peripheral nerve tension testing.
• Select neural mobilizations based on findings from neurodynamic testing and peripheral nerve tension testing.
Backstory
Neural Anatomy

• Nervous system divided into central nervous system (CNS) and peripheral nervous system (PNS)

• PNS pathways
  – Afferent
  – Efferent
  – Autonomic

https://www.apa.org/helpcenter/stress/effects-nervous
Upper Extremity Neural Anatomy

https://en.wikipedia.org/wiki/Median_nerve#/media/File:Nerves_of_the_left_upper_extremity.gif
Lower Extremity Neural Anatomy

https://en.wikipedia.org/wiki/Tibial_nerve#/media/File:Gray832.png
Lower Extremity Neural Anatomy
Lower Extremity Neural Anatomy

Tibial S. 1.2.
Sural S. 1.2.
Saphenous L. 3.4.
Medial plantar L. 4.5.
Lateral plantar S. 1.2.

Neurodynamics

- With motor movement, such as athletic participation, the nerves and surrounding connective tissues glide with the movement (Shacklock 2005)

http://eznetpublish.ihealthspot.com/
### Table 3. Median Nerve Excursion

<table>
<thead>
<tr>
<th>Direction</th>
<th>Average Distance</th>
<th>Joint</th>
<th>Motion</th>
<th>Average Distance</th>
<th>Joint</th>
<th>Motion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distal</td>
<td>24 mm</td>
<td>Shoulder</td>
<td>ABD 30°</td>
<td>15 mm</td>
<td>Shoulder</td>
<td>ABD 30°</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Elbow</td>
<td>Flex 90°</td>
<td></td>
<td>Elbow</td>
<td>Flex 10°</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Forearm</td>
<td></td>
<td></td>
<td>Forearm</td>
<td>Pron 60°</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wrist</td>
<td>Ext 60°</td>
<td></td>
<td>Wrist</td>
<td>Ext 60°</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Finger</td>
<td>Ext 35°</td>
<td></td>
<td>Finger</td>
<td>Ext 35°</td>
</tr>
<tr>
<td>Proximal</td>
<td>12 mm</td>
<td>Shoulder</td>
<td>ABD 110°</td>
<td>15 mm</td>
<td>Shoulder</td>
<td>ABD 110°</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Elbow</td>
<td>Flex 10°</td>
<td></td>
<td>Elbow</td>
<td>Flex 90°</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Forearm</td>
<td></td>
<td></td>
<td>Forearm</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wrist</td>
<td>Flex 60°</td>
<td></td>
<td>Wrist</td>
<td>Flex 60°</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Finger</td>
<td>Flex 35°</td>
<td></td>
<td>Finger</td>
<td>Flex 35°</td>
</tr>
</tbody>
</table>

Excursion of the median nerve measured at the wrist and elbow adapted from the work of Wright and associates.23

ABD = abduction; Flex = flexion; Pron = pronation; Ext = extension.

### TABLE 4. Ulnar Nerve Excursion

<table>
<thead>
<tr>
<th>Direction</th>
<th>Wrist Average Distance</th>
<th>Joint</th>
<th>Motion</th>
<th>Elbow Average Distance</th>
<th>Joint</th>
<th>Motion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distal</td>
<td>13 mm</td>
<td>Shoulder</td>
<td>ABD 30</td>
<td>11 mm</td>
<td>Shoulder</td>
<td>ABD 30</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Elbow</td>
<td>Flex 10</td>
<td></td>
<td>Elbow</td>
<td>Flex 90</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Forearm</td>
<td>Pron</td>
<td></td>
<td>Forearm</td>
<td>Pron</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wrist</td>
<td>Ext 60</td>
<td></td>
<td>Wrist</td>
<td>Ext 60</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RD</td>
<td></td>
<td></td>
<td>RD</td>
<td></td>
</tr>
<tr>
<td>Proximal</td>
<td>11 mm</td>
<td>Finger</td>
<td>Ext 35</td>
<td>5 mm</td>
<td>Finger</td>
<td>Ext 35</td>
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<tr>
<td></td>
<td></td>
<td>Shoulder</td>
<td>ABD 110</td>
<td></td>
<td>Shoulder</td>
<td>ABD 110</td>
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<tr>
<td></td>
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<td>Elbow</td>
<td>Flex 90</td>
<td></td>
<td>Elbow</td>
<td>Flex 10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Forearm</td>
<td>Sup</td>
<td></td>
<td>Forearm</td>
<td>SUP</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wrist</td>
<td>Flex 60</td>
<td></td>
<td>Wrist</td>
<td>Flex 60</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>UD</td>
<td></td>
<td></td>
<td>UD</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Finger</td>
<td>Flex 35</td>
<td></td>
<td>Finger</td>
<td>Flex 35</td>
</tr>
</tbody>
</table>

Excursion of the ulnar nerve measured at the wrist and elbow adapted from the work of Wright and associates.\(^{24}\)

ABD = abduction; Flex = flexion; Pron = pronation; Ext = extension; RD = radial deviation; Sup = supination; UD = ulnar deviation.

• Nerve fibers and the surrounding connective tissue are susceptible to injury
• How the nerve responds to injury (Carp 2015)
  – Neuropraxia – axon conduction is blocked due to a physiologic process without a histological change
  – Axonotmesis – loss of continuity of the nerve with continuity of the connective sheaths
  – Neurotmesis – loss of axon including the connective tissue
• Injury of the neural tissue and surrounding areas may result in scaring and neurodynamics restrictions (Shacklock 2005; Carp 2015)

• Symptoms of neurodynamic restrictions include numbness or tingling with movement and/or a deep uncomfortable sensation which has never been felt before (Shacklock 2005; Carp 2015)
With motor movement, such as athletic participation, the nerves and surrounding connective tissues glide with the movement (Shacklock 2005).
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Video Demonstrations with Dr. Grahovec
Neurodynamic Testing

- Straight Leg Raise Test
- Prone Knee Bend
- Median Nerve Traction Test
- Radial Nerve Traction Test
- Ulnar Nerve Traction Test
Additional Neural Diagnostic Tests

- Examination of motor function
- Sensory examination
- Integumentary and vascular examination
- Deep tendon reflexes (DTR)
- Abdominal reflex
- Babinski reflex
- Tinel sign
- Functional examination
<table>
<thead>
<tr>
<th>Sign/Symptom</th>
<th>Neural Tissue</th>
<th>Non-Neural Tissue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tissue example</td>
<td>Median nerve</td>
<td>Biceps tendon</td>
</tr>
<tr>
<td>Description of pain</td>
<td>“Unusual, never felt anything like this, deep, uncomfortable, toothache like, numbness, pins and needles”</td>
<td>“A pulled muscle, like I worked out too much, a sharp pain”</td>
</tr>
<tr>
<td>Constancy of pain</td>
<td>Prolonged perception after stretch; does not immediately decrease</td>
<td>Once tension removed, symptoms decrease rapidly</td>
</tr>
<tr>
<td>Palpation symptoms</td>
<td>Causes radicular symptoms in specific innervation pattern</td>
<td>Local pain and tenderness occasionally with myotomal or dermatomal reference</td>
</tr>
<tr>
<td>Visualization</td>
<td>Therapist may see muscle fasciculations</td>
<td>Occasional muscle spasms</td>
</tr>
</tbody>
</table>
Neural Gliding vs Neural Sliding

- Neural Gliding
  - Fixation of proximal portion of the nerve
  - Distal portion of nerve in controlled stretch
  - Symptoms typically occur distal aspect of nerve
Neural Gliding vs Neural Sliding

- Neural Sliding ("Flossing")
  - Movement of proximal end toward distal end with simultaneous elongating of distal end
  - Movement of distal end toward proximal end with simultaneous elongating of proximal end

Figure 3: Neurodynamic Mobilization can be either, sliding (left) or tensioning (right), depending on the synchronization of limbs and axial movements. In this illustration, upper limb and neck/head can move in the same or opposite directions.

Neural Gliding vs Neural Sliding

A: Sliding technique
B: Tensioning technique
C-F: Gliding Techniques

• Combine neural mobilization with other interventions.
• Minimize the effects of inflammation and avoid any additive inflammation through undue stresses.
• Be cognizant that physiologic responses to nerve mobilization are typically much greater than with contractile and other noncontractile tissues.
• Ensure only the exact prescribed mobilization is being performed and that all extraneous joint movement is controlled.
• Instruct the patient in the prescribed frequency, repetition, duration, and intensity of the prescribed self-management techniques.
Neural Mobilization Guidelines

• Limit excursion to the onset of symptoms, hold for short period of time, and then release.
• Daily reexamination pre- and post-intervention is required in order to identify the stage of healing.
• Home self-management is often delayed until similar techniques are tolerated during formal therapy sessions and the patient’s ability to handle such stresses is established.
• Examination procedures become the intervention.
Neurodynamic mobilization and foam rolling improved delayed-onset muscle soreness in a healthy adult population: a randomized controlled clinical trial

Blanca Romero-Moraleda¹,², Roy La Touche², Sergio Lerma-Lara², Raúl Ferrer-Peña², Víctor Paredes¹, Ana Belén Peinado³ and Daniel Muñoz-García²

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³ Laboratory of Exercise Physiology Research Group, Department of Health and Human Performance, School of Physical Activity and Sport Sciences-INEF, Technical University of Madrid, Madrid, Spain

* These authors contributed equally to this work.
# Neurodynamic Evidence

<table>
<thead>
<tr>
<th>Variable</th>
<th>Groups</th>
<th>Baseline</th>
<th>Pretreatment</th>
<th>Posttreatment</th>
<th>Friedman (p-value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NPRS (0–10)</td>
<td>FR</td>
<td>0</td>
<td>7 (4.37–8.00)</td>
<td>3.5 (3.5–6.00)</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td>NM</td>
<td>0</td>
<td>4 (3–6.75)</td>
<td>2 (1–3.75)</td>
<td>0.01</td>
</tr>
<tr>
<td>Strength (Kg)</td>
<td>FR</td>
<td>135.15 (115.025–158.57)</td>
<td>122.30 (110.50–151.15)</td>
<td>131.25 (112.30–175.02)</td>
<td>0.02</td>
</tr>
<tr>
<td></td>
<td>NM</td>
<td>138.35 (105.90–158.85)</td>
<td>129.35 (105.90–158.77)</td>
<td>141.15 (109.55–150.77)</td>
<td>0.17</td>
</tr>
</tbody>
</table>

**Notes.**
- NPRS, Numeric Pain Rating Scale; Strength, isometric hand held dynamometer; FR, Foam Roller group; NM, Neurodynamic Mobilization group.
Neurodynamic Evidence

[RESEARCH REPORT]

ANNAIE BASSON, PhD¹ • BENITA OLIVIER, PhD¹ • RICHARD ELLIS, PhD²
MICHEL COPPIETERS, PhD³•• • AIMEE STEWART, PhD¹ • WITNESS MUDZI, PhD¹

The Effectiveness of Neural Mobilization for Neuromusculoskeletal Conditions: A Systematic Review and Meta-analysis
Neurodynamic Evidence

- Neural mobilization was effective for nerve-related low back pain, nerve-related neck and arm pain, and plantar heel pain and tarsal tunnel syndrome.

- Neural mobilization was not effective in the management of carpal tunnel syndrome.
Mobilization of the contralateral limb in Slump position: effects on knee extension in healthy adult subjects

Leonardo Pelliciari¹, Matteo Paci¹, Tommaso Geri¹, Daniele Piscitelli², Marco Baccini³

¹Department of Neurorehabilitation, IRCCS San Raffaele Pisana, Rome, Italy; ²Unit of Functional Rehabilitation, Azien USL Toscana Centro, Florence, Italy; ³Department of Neuroscience, Rehabilitation, Ophthalmology Genetics, Maternal and Child Health, University of Genoa – Campus of Savona, Savona, Italy; ⁴School of Physical and Occupational Therapy, McGill University, Montreal, Canada; ⁵Cardiothoracic Rehabilitation Service, Department of Healthcare Professionals, Azienda Ospedaliero-Universitaria Careggi, Florence, Italy

Figure 2. Experimental manoeuvre. The researcher carried out a passive mobilization of the left knee into extension (while maintaining the ankle in dorsiflexion maximum) from the Slump position (A) until the achievement of the second resistance (B).
Neurodynamic Evidence

Mobilization of the contralateral limb in Slump position: effects on knee extension in healthy adult subjects

Leonardo Pellicciari², Matteo Paci³, Tommaso Geri³, Daniele Piscitelli³, Marco Baccini³

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• Neural mobilization increased knee extension range of motion of contralateral limb
• May have occurred through displacement of the sciatic nerve of the ipsilateral nerve root
Effects of a Novel Neurodynamic Tension Technique on Muscle Extensibility and Stretch Tolerance: A Counterbalanced Crossover Study

Max Pietrzak and Niels B.J. Vollaard
**Figure 2** — Modified long sit slump (MLSS). Start position (top row: 2A&2B) and end position (bottom row: 2C&2D). The subject starts semi-sitting with the stretched limb on the plinth and the knee flexed. The subject uses the opposite hand to reach forward and hold the lateral border of the foot, placing it in dorsiflexion and eversion and is then instructed to extend the knee and internally rotate the femur. The therapist assists to facilitate neurodynamic tension positions, and if the position is well tolerated, the subject is facilitated to add further trunk and cervical flexion.
Effects of a Novel Neurodynamic Tension Technique on Muscle Extensibility and Stretch Tolerance: A Counterbalanced Crossover Study

Max Pietrzak and Niels B.J. Vollaard

• Passive straight-leg raise and prone knee bend displayed significant improvements of 5 deg – 9 deg of increased motion bilaterally

• Significantly increased stretch tolerance of the participants before and after treatment
Literature Review

Effects of neurodynamic treatment on hamstrings flexibility: A systematic review and meta-analysis

Laura López López, Janet Rodríguez Torres, Araceli Ortiz Rubio, Irene Torres Sánchez, Irene Cabrera Martos, Marie Carmen Valenza*

Department of Physiotherapy, Faculty of Health Sciences, University of Granada, Spain
• Neurodynamic mobilization showed a medium effect (0.7) on knee extension range of motion when compared to manual therapy
• Neurodynamic mobilization showed a large effect (1.2 5) on tissue extensibility when compared to other manual therapy
The immediate effect of neurodynamic techniques on jumping performance: A randomised double-blind study

Cihan C. Aksoy, Vedat Kurt, Ismail Okur, Ferruh Taspinar, and Betül Taspinar

*Department of Physiotherapy and Rehabilitation, Health Sciences Faculty, KUAKYA Health Science University, Evliya Celebi Campus, 43444 Kuahya, Turkey

bDepartment of Physiotherapy and Rehabilitation, Health Sciences Faculty, Izmir Democracy University, Izmir, Turkey
The immediate effect of neurodynamic techniques on jumping performance: A randomised double-blind study

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\textsuperscript{a}Department of Physiotherapy and Rehabilitation, Health Sciences Faculty, Kocaeli Health Science University, Eviya Celebi Campus, 41444 Kocaeli, Turkey
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Table 3
Intragroup comparison of jump performances of pre- and post-intervention

<table>
<thead>
<tr>
<th>Variables</th>
<th>Pre-intervention X ± SD</th>
<th>Post-intervention X ± SD</th>
<th>p#</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>FNM Vertical jump (cm)</td>
<td>34.56 ± 7.80</td>
<td>35.89 ± 8.15</td>
<td>0.00</td>
<td>1.55</td>
</tr>
<tr>
<td>FNM Horizontal jump (cm)</td>
<td>205.23 ± 34.49</td>
<td>205.78 ± 34.47</td>
<td>0.70</td>
<td>0.14</td>
</tr>
<tr>
<td>SNM Vertical jump (cm)</td>
<td>31.74 ± 8.31</td>
<td>32.76 ± 8.45</td>
<td>0.03</td>
<td>0.86</td>
</tr>
<tr>
<td>SNM Horizontal jump (cm)</td>
<td>192.98 ± 40.05</td>
<td>194.20 ± 37.96</td>
<td>0.44</td>
<td>0.24</td>
</tr>
</tbody>
</table>

cm: centimeter, d: effect size, FNM: femoral nerve mobilization, SNM: sciatic nerve mobilization. # Independent samples t-test.
• Neural mobilization has been shown to be effective in:
  – reducing pain perception related to delayed onset muscle soreness
  – decreasing neck and back pain
  – improving lower flexibility and range of motion
  – improving stretch tolerance
  – improving vertical jumping performance

• Still yet, more research is needed to fully understand neurodynamic and treatment of neurodynamic restriction
Questions?
References


