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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.

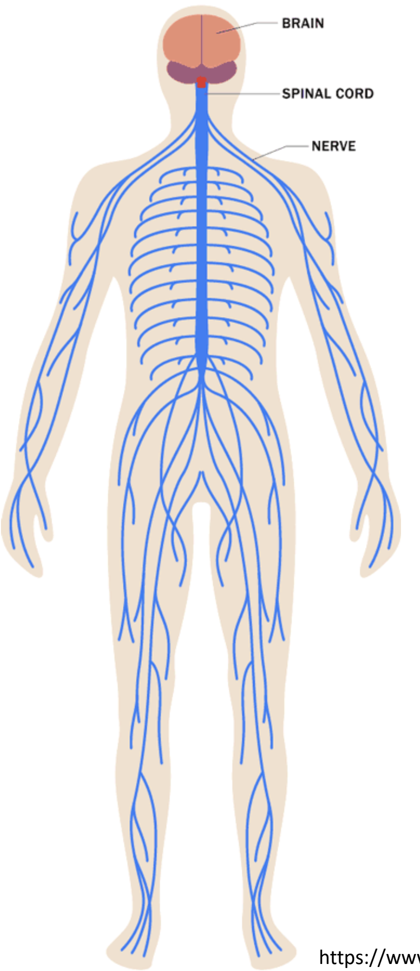
Backstory

https://giphy.com/gifs/ballsdeep-viceland-balls-deep-26tnilI2HHKZCMLgA

Neural Anatomy

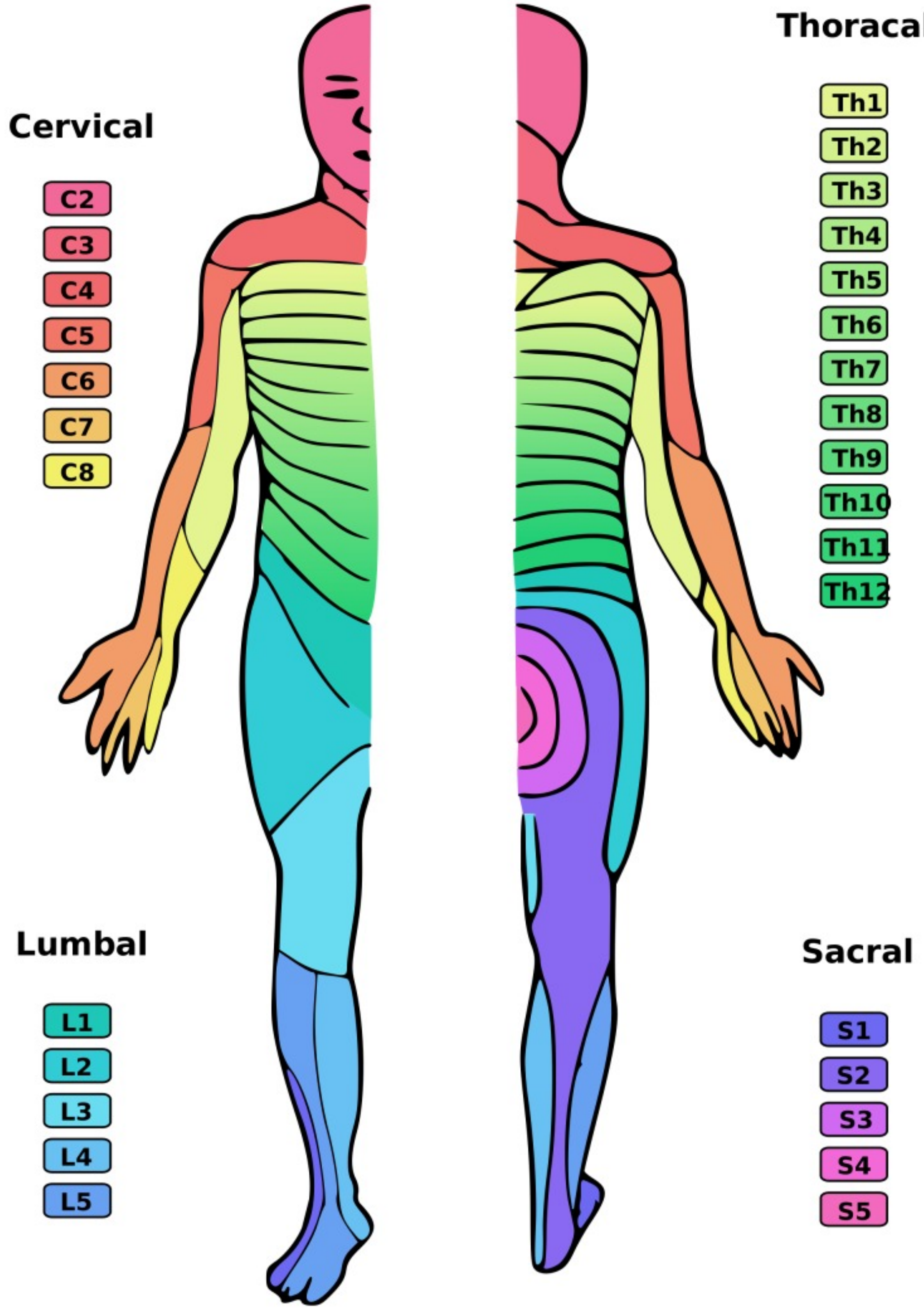
- Nervous system divided into central nervous system (CNS) and peripheral nervous system (PNS)

- PNS pathways
  - Afferent
  - Efferent
  - Autonomic



https://www.apa.org/helpcenter/stress/effects-nervous

Dermatome Map



https://www.ncbi.nlm.nih.gov/books/NBK5354
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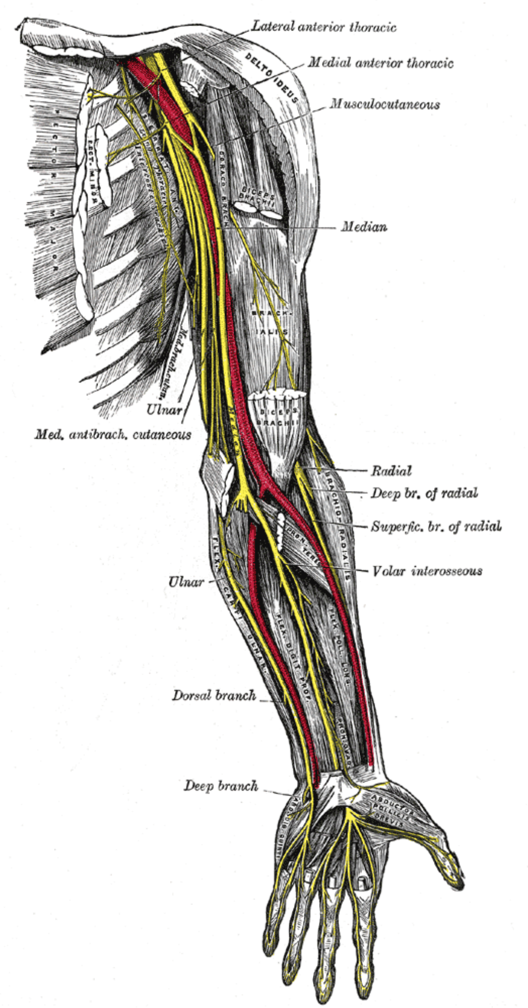
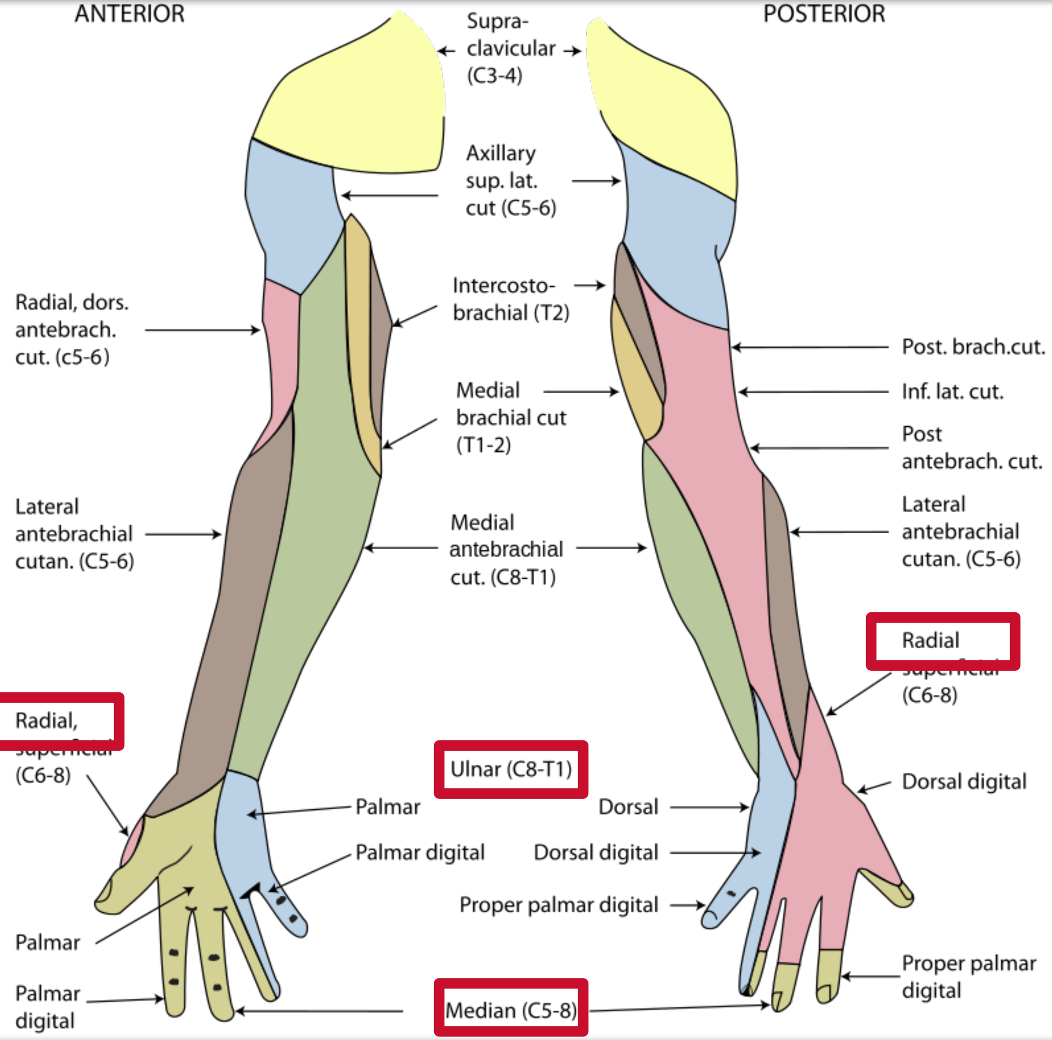
Upper Extremity Neural Anatomy



https://en.wikipedia.org/wiki/Median_nerve#/media/File:Nerves_of_the_left_upper_extremity.gif

Upper Extremity Neural Anatomy



https://en.wikipedia.org/wiki/Nerve_supply_of_the_human_arm#/media/File:Gray812and814.svg

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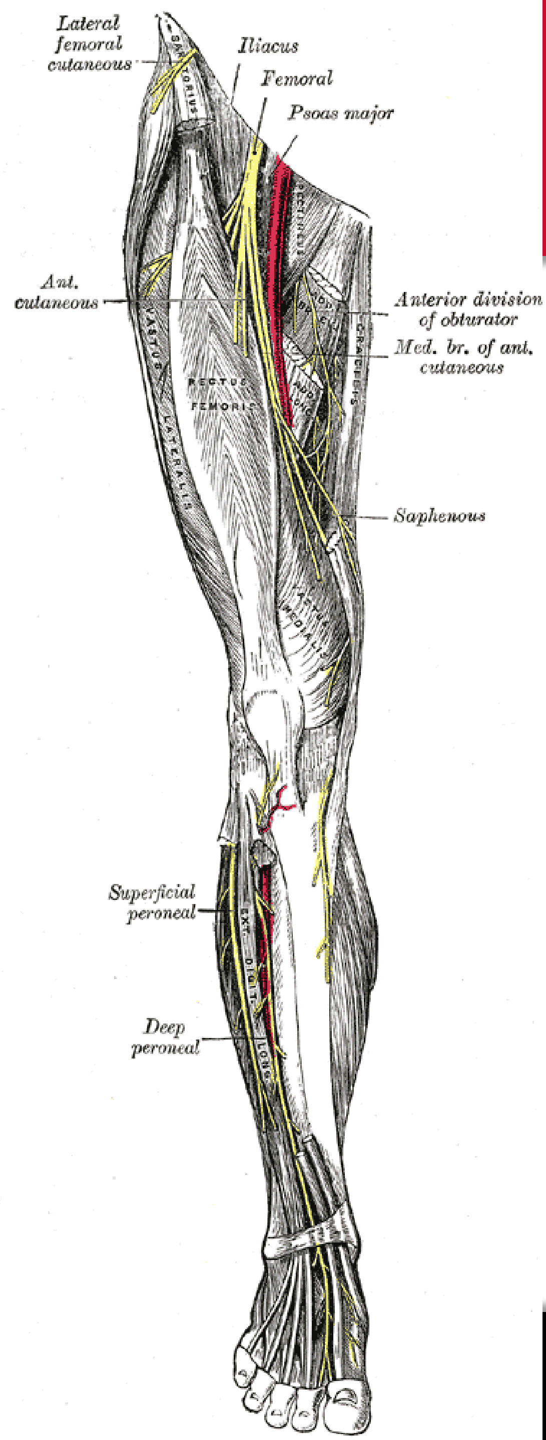
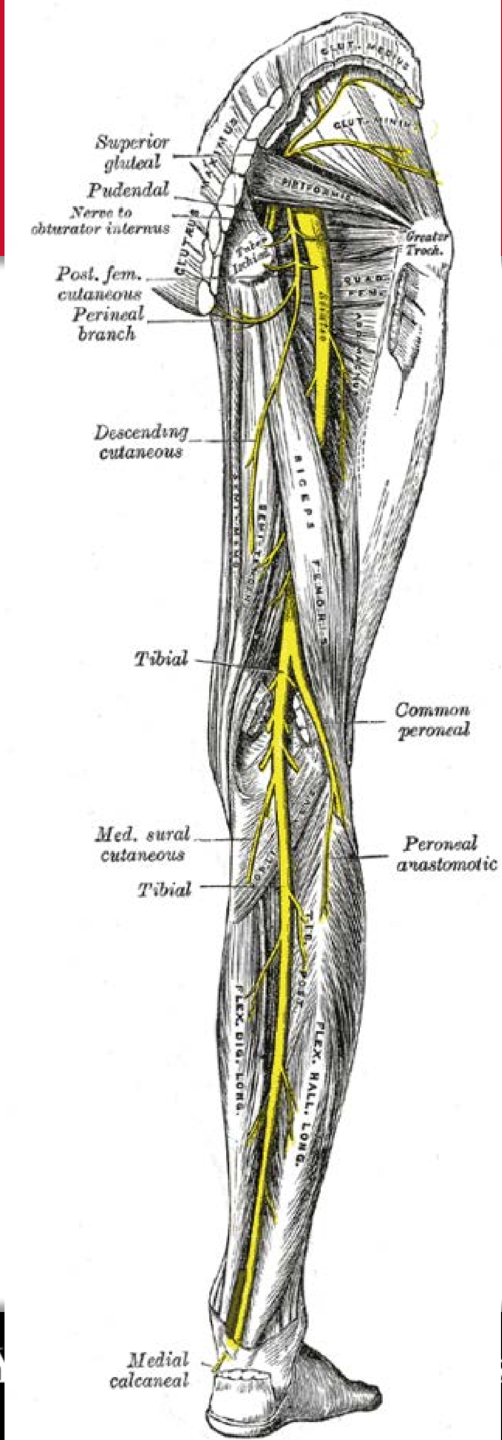
Lower Extremity Neural Anatomy



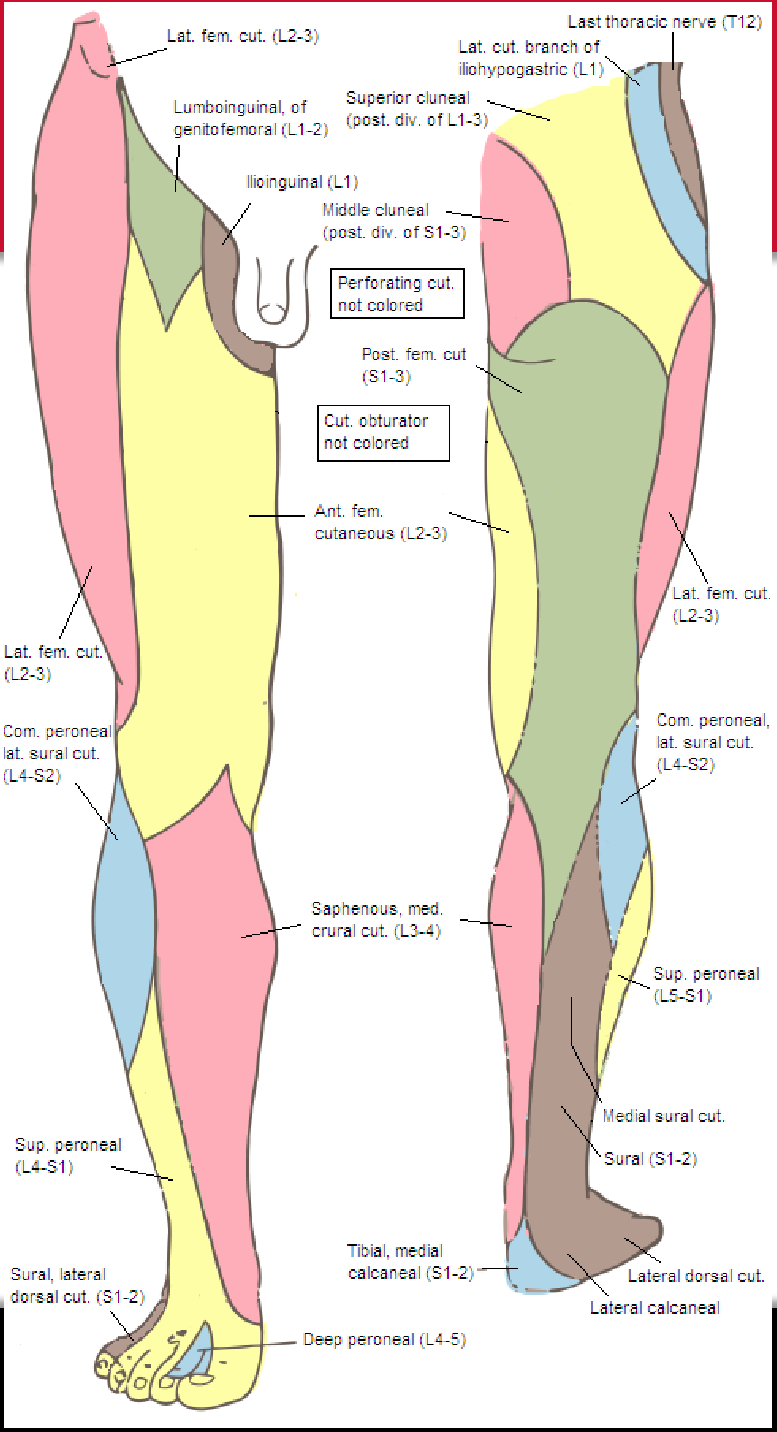
https://en.wikipedia.org/wiki/Tibial_nerve#/media/File:Gray832.png

Lower Extremity Neural Anatomy

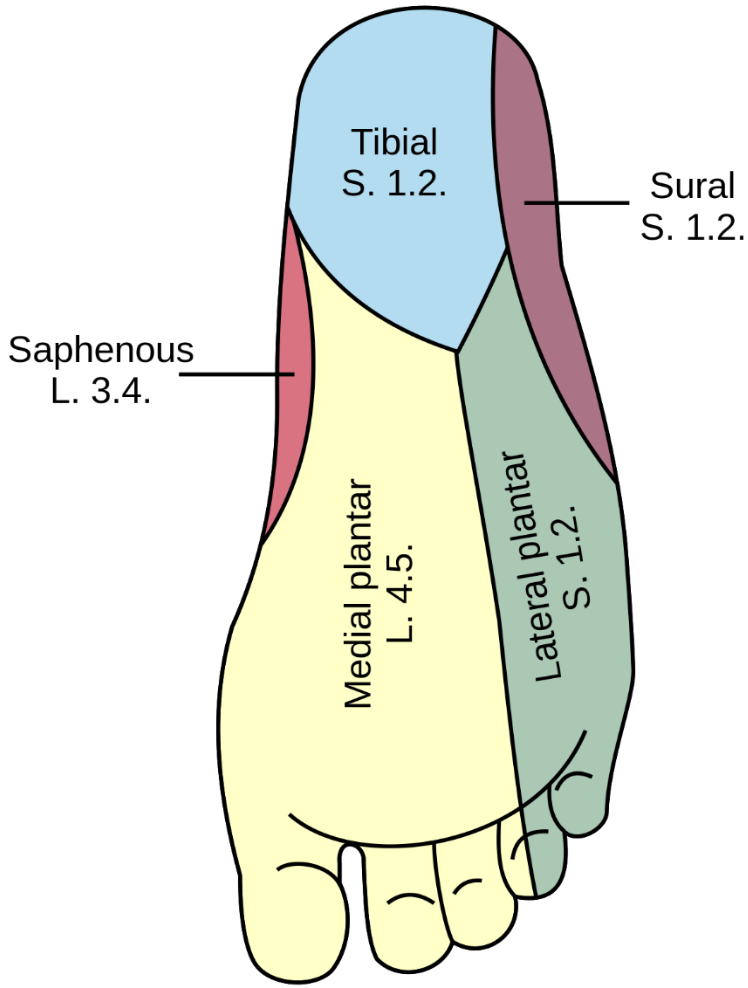


https://en.wikipedia.org/wiki/Tibial_nerve#/media/File:Gray832.png

Lower Extremity Neural Anatomy



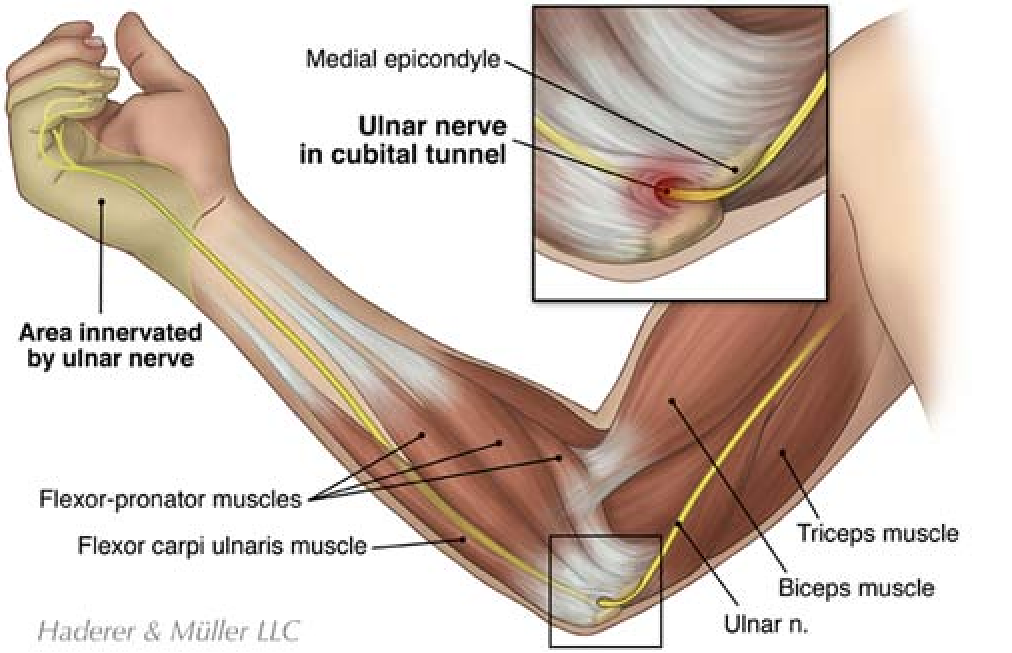
Lower Extremity Neural Anatomy



https://en.wikipedia.org/wiki/Nerve_supply_of_the_human_leg#/media/File:Gray834.svg

Neurodynamics

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



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Median Nerve Excursion

TABLE 3. Median Nerve Excursion

	Wrist			Elbow		
Direction	*Average Distance*	*Joint*	*Motion*	*Average Distance*	*Joint*	*Motion*
Distal	24 mm	Shoulder	ABD 30°	15 mm	Shoulder	ABD 30°
		Elbow	Flex 90°		Elbow	Flex 10°
		Forearm			Forearm	Pron 60°
		Wrist	Ext 60°		Wrist	Ext 60°
		Finger	Ext 35°		Finger	Ext 35°
Proximal	12 mm	Shoulder	ABD 110°	15 mm	Shoulder	ABD 110°
		Elbow	Flex 10°		Elbow	Flex 90°
		Forearm			Forearm	
		Wrist	Flex 60°		Wrist	Flex 60°
		Finger	Flex 35°		Finger	Flex 35°

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.

MT Walsh. Upper limb neural tension testing and mobilization: fact, fiction, and practical approach. *J Hand Ther.* 2005;18(2):241-258

Median Nerve Excursion

TABLE 4. Ulnar Nerve Excursion

	Wrist			Elbow		
Direction	*Average Distance*	*Joint*	*Motion*	*Average Distance*	*Joint*	*Motion*
Distal	13 mm	Shoulder	ABD 30	11 mm	Shoulder	ABD 30
		Elbow	Flex 10		Elbow	Flex 90
		Forearm	Pron		Forearm	Pron
		Wrist	Ext 60		Wrist	Ext 60
			RD			RD
		Finger	Ext 35		Finger	Ext 35
Proximal	11 mm	Shoulder	ABD 110	5 mm	Shoulder	ABD 110
		Elbow	Flex 90		Elbow	Flex 10
		Forearm	Sup		Forearm	SUP
		Wrist	Flex 60		Wrist	Flex 60
			UD			UD
		Finger	Flex 35		Finger	Flex 35

Excursion of the ulna 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.

MT Walsh. Upper limb neural tension testing and mobilization: fact, fiction, and practical approach. *J Hand Ther.* 2005;18(2):241-258

Neural Injury

- Nerve fibers and the surrounding connective tissue are susceptible to injury
- How the nerve responses 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

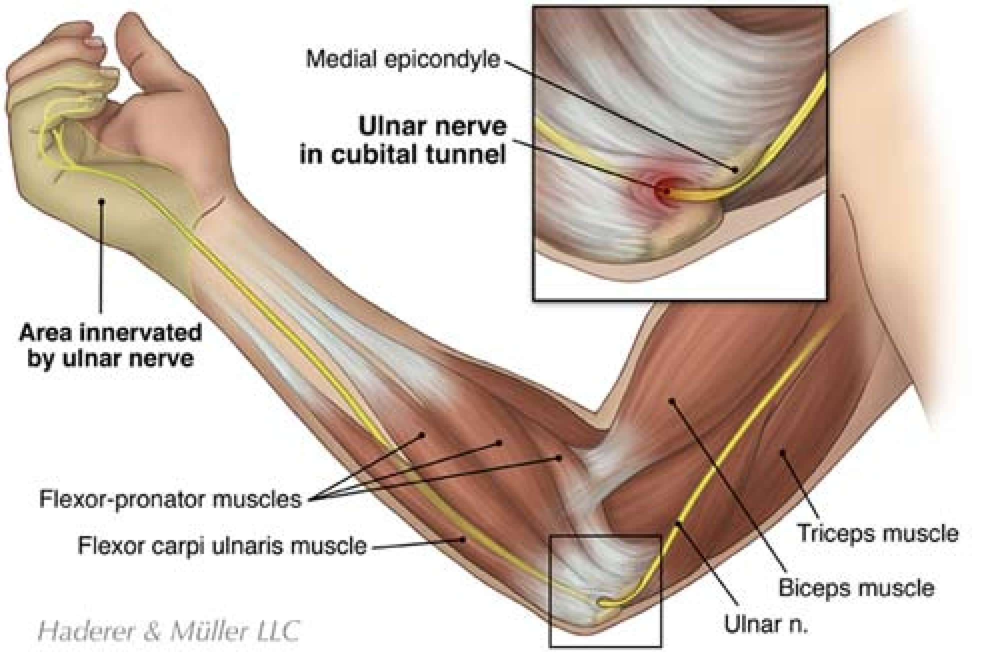
Neural Injury

- 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)

Neurodynamics (Restrictions)

- 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

Neural vs Non-Neural[10]

Sign/Symptom	Neural Tissue	Non-Neural Tissue
Tissue example	Median nerve	Biceps tendon
Description of pain	"Unusual, never felt anything like this, deep, uncomfortable, toothache like, numbness, pins and needles"	"A pulled muscle, like I worked out too much, a sharp pain"
Constancy of pain	Prolonged perception after stretch; does not immediately decrease	Once tension removed, symptoms decrease rapidly
Palpation symptoms	Causes radicular symptoms in specific innervation pattern	Local pain and tenderness occasionally with myotomal or dermatomal reference
Visualization	Therapist may see muscle fasciculations	Occasional muscle spasms

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.

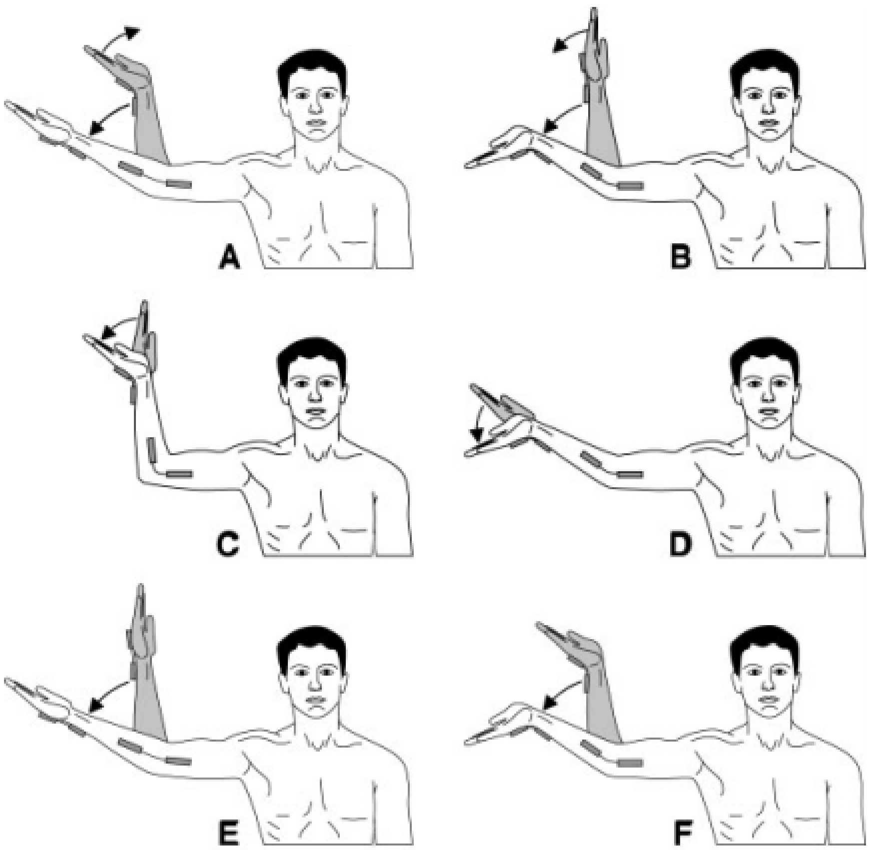
Santana HHS, Fernandes de Oliveira IAV, Medrado AP, Nunes Sá K, et al., (2015) Neurodynamic Mobilizatio and Peripheral NerveRegeneration: A Narrative Review. Int J Neurorehabilitation 2: 1000163.

Neural Gliding vs Neural Sliding

A :Sliding technique

B : Tensioning technique

C-F : Gliding Techniques



Coppieters MW, Alshami, AM. Longitudinal excursion and strain in the median nerve during novel nerve gliding exercises for carpal tunnel syndrome. *J Ortho Res.* 2007; 25:972-980.

Neural Mobilization Guidelines[3]

- 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[3]

- 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 Evidence

PeerJ

Neurodynamic mobilization and foam rolling improved delayed-onset muscle soreness in a healthy adult population: a randomized controlled clinical trial

Blanca Romero-Moraleda[1,3,*], Roy La Touche[2,*], Sergio Lerma-Lara[2,*], Raúl Ferrer-Peña[2,*], Víctor Paredes[1,*], Ana Belén Peinado[3,*] and Daniel Muñoz-García[2,*]

[1] Healthy Sciences Faculty, Camilo José Cela University, Madrid, Spain
[2] Departamento de Fisioterapia and Motion in Brains Research Group, Instituto de Neurociencias y Ciencias del Movimiento, Centro Superior de Estudios Universitarios La Salle, Universidad Autónoma de Madrid, Spain
[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 2 **Median and inter-quartil data of pain and strength.**

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

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

Neurodynamic Evidence

[RESEARCH REPORT]

ANNALIE BASSON, PhD[1] • BENITA OLIVIER, PhD[1] • RICHARD ELLIS, PhD[2]
MICHEL COPPIETERS, PhD[3-5] • AIMEE STEWART, PhD[1] • WITNESS MUDZI, PhD[1]

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

Neurodynamic Evidence

[RESEARCH REPORT]

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MICHEL COPPIETERS, PhD[3-5] • AIMEE STEWART, PhD[1] • WITNESS MUDZI, PhD[1]

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

- 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

Neurodynamic Evidence

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

Leonardo Pellicciari[1], Matteo Paci[2], Tommaso Geri[3], Daniele Piscitelli[4], Marco Baccini[5]

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

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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

Neurodynamic Evidence

Journal of Sport Rehabilitation, 2018, 27, 55-65
https://doi.org/10.1123/jsr.2016-0171

Human Kinetics
ORIGINAL RESEARCH REPORT

Effects of a Novel Neurodynamic Tension Technique on Muscle Extensibility and Stretch Tolerance: A Counterbalanced Crossover Study

Max Pietrzak and Niels B.J. Vollaard

Neurodynamic Evidence

Figure 2 — Modified long sit slump (MLSS). Start position (top row; 2A&2B) and end position (bottom row; 2C&2D). The subject starts hemi-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.

Neurodynamic Evidence

Journal of Sport Rehabilitation, 2018, 27, 55-65
https://doi.org/10.1123/jsr.2016-0171

Human Kinetics
ORIGINAL RESEARCH REPORT

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

Neurodynamic Evidence

Physical Therapy in Sport 40 (2019) 244–250

Contents lists available at ScienceDirect

Physical Therapy in Sport

journal homepage: www.elsevier.com/ptsp

Literature Review

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

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

Department of Physiotherapy, Faculty of Health Sciences, University of Granada, Spain

Neurodynamic Evidence

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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

Neurodynamic Evidence

Journal of Back and Musculoskeletal Rehabilitation 33 (2020) 15–20
DOI 10.3233/BMR-170878
IOS Press

The immediate effect of neurodynamic techniques on jumping performance: A randomised double-blind study

Cihan C. Aksoy[a], Vedat Kurt[a,*], Ismail Okur[a], Ferruh Taspinar[b] and Betül Taspinar[b]
[a]*Department of Physiotherapy and Rehabilitation, Health Sciences Faculty, Kutahya Health Science University, Evliya Celebi Campus, 43444 Kutahya, Turkey*
[b]*Department of Physiotherapy and Rehabilitation, Health Sciences Faculty, Izmir Democracy University, Izmir, Turkey*

Neurodynamic Evidence

Journal of Back and Musculoskeletal Rehabilitation 33 (2020) 15–20
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[a]Department of Physiotherapy and Rehabilitation, Health Sciences Faculty, Kutahya Health Science University, Evliya Celebi Campus, 43444 Kutahya, Turkey
[b]Department of Physiotherapy and Rehabilitation, Health Sciences Faculty, Izmir Democracy University, Izmir, Turkey

Table 3
Intragroup comparison of jump performances of pre- and post-intervention

Variables	Pre-intervention X ± SD	Post-intervention X ± SD	$p^{\#}$	d
FNM				
Vertical jump (cm)	34.56 ± 7.80	35.89 ± 8.15	**0.00**	**1.55**
Horizontal jump (cm)	205.23 ± 34.49	205.78 ± 34.47	0.70	0.14
SNM				
Vertical jump (cm)	31.74 ± 8.31	32.76 ± 8.45	**0.03**	**0.86**
Horizontal jump (cm)	192.98 ± 40.05	194.20 ± 37.96	0.44	0.24

cm: centimeter, d: effect size, FNM: femoral nerve mobilization, SNM: sciatic nerve mobilization. #Independent samples t-test.

Bottom Line

- 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?

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