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LOWER EXTREMITY NEURODYNAMICS

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Orthopaedic Manual Physical Therapy Series
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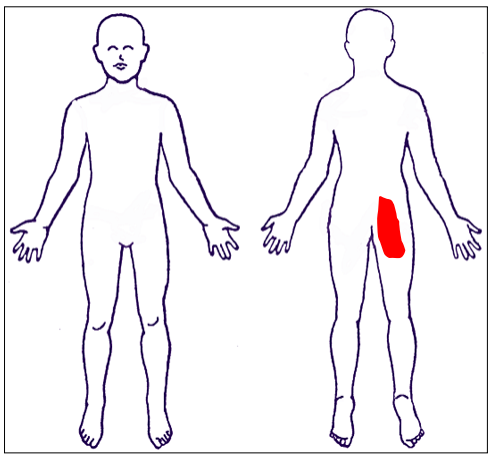
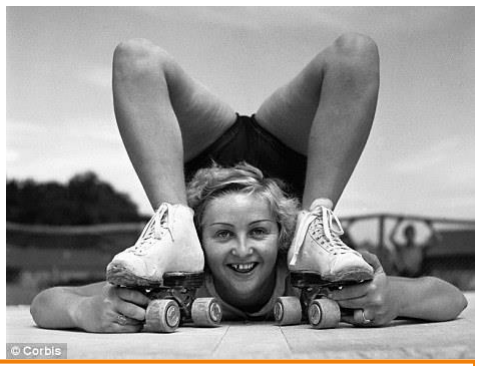


Body Chart Initial Hypothesis?

- L 4-5, 5-S1 disc, facet
- L 4-5, 5-S1 radiculopathy
- SIJ pain
- Extra-articular hip pathology



Subjective Exam

- 30 y.o. female customer service rep with R buttock pain
- Pain began last week after 5 hour drive and has been present since
- Aching a little while she was driving then intensified when she reached in her backseat to get her purse when she was getting ready to get out of the car
- Aggs: sitting > 10min, standing > 30 min, tying her shoes
- Eases: walking reduces it by 75%, L SL eliminates pain
- Pain is worst upon waking and then worsens throughout the day when sitting or static standing
- Oswestry: 25%
- Unremarkable PMH

Structure at Fault

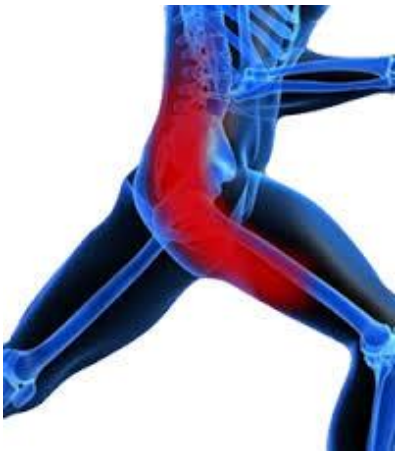
- Joints:
  - L 4-S1 facet, SIJ, hip
- Myofascial Tissue:
  - LB multifidus, glutes, piriformis, Hamstring
- Noncontractile Tissue:
  - L4-S1 disc, iliolumbar ligament, sacrum
- Neural Tissue:
  - L4-S1 nerve root, Sciatic nerve
- Other structures:
  - Osteophytes at facet, mass

Primary Hypothesis After Subjective Exam

- L4-5/L5-S1 disc pathology

Differential Diagnosis

- L4-S1 facet
- SIJ dysfunction
- Hip pathology



Objective Exam Asterisks

- Posture
  - Pt stands w/increased L WB
- LB ROM
  - limited and reproduction of pain w/Flex
  - Decreased pain w/Ext
- Joint mobility
- (+) local pain PA R 4,5 and R sacral base
- (+) L4,5 L SB PPIVMS
- (-) PAIVMs
- DTR, myotomes, dermatomes WNL
- Neurodynamic testing
  - (+) slump—reproduction of symptoms
  - (+) SLR—reproduction of symptoms

Base Lower Extremity Neurodynamic Tests

- Straight leg raise (SLR)—sciatic tension bias
- Slump--central dural to distal LE tension
- Slump knee bend (SKB)—femoral nerve tension bias
- Prone knee bend (PKB)—femoral nerve tension bias

SLR Test

- Indications:
  - Assess a low lumber discogenic problem, thoracic or LB spine clearing, and lower quarter disorders. Originally designed to test sciatic nerve.

"The sensitivity and specificity of the slump and the straight leg raising tests in patients with lumbar disc herniation."
Journal of Clinical Rheumatoloty 2008

- SLR
  - Primary test to differentially diagnose HNP w/nerve root compression (especially pts requiring surgery)
  - Creates L5, S1 root traction (2-6 mm tension)
  - Normal response: 70-90 deg hip flexion with tightness at posterior thigh
  - Beyond 70 deg flex is stretching sciatic nerve -- compression of sciatic outside spinal canal
  - HNP specificity .89, sensitivity .52
    - Medial hip rotation can decrease SLR sensitivity due to it increasing sciatic tension and neuro symptoms—easier to control when using slump

Normal inter-limb differences during the straight leg raise neurodynamic test: a cross sectional study

Boyd and Villa *BMC Musculoskeletal Disorders* 2012, **13**:245
http://www.biomedcentral.com/1471-2474/13/245

Benjamin S Boyd[1*] and Philip S Villa[2]

- Tested 40 healthy individuals SLR
- Interlimb SLR differences in 90% of participants were within 11°

SLR Test

- Method:
  - The patient lies supine, trunk and hips in neutral position. The therapist place one hand under the Achilles tendon and the other hand above the knee preventing knee flexion.
  - The limb is lifted straight into hip flexion. Notice the range that is recorded before pain or symptoms are provoked.
- Normal response:
  - The normal range for SLR range between 50-100°
  - Main symptoms areas: posterior thigh, posterior knee, posterior calf to foot

SLR Sensitizers

- Add sensitizing movements and ASSESS as each component is added
- Sensitizing additions—based on area of symptoms
  - Ankle DF or DF/eversion stresses tibial nerve.
  - DF w/Inversion stresses sural nerve
  - Ankle PF w/Inversion stresses common peroneal nerve.
  - Cervical flexion stresses SC, meninges and further stresses sciatic nerve
  - Hip IR stresses common peroneal nerve
  - Hip adduction further stresses sciatic nerve.

SLR Technique Concerns

- Knee MUST be held in full extension
- Must control hip ER/IR
- Therapist must weight shift from beginning to end of test to control pt's LE

SLR—Sciatic/Dural Test

- Pt supine, trunk and hips in neutral position.
- PT places one hand under the Achilles tendon and the other hand above the knee preventing knee flexion.
- Limb is lifted straight into hip flexion. Notice ROM before pain or symptoms are provoked.
- Add DF or Cerv flexion for structural differentiation (depends on prox or distal symptoms)

SLR Sensitizers—Tibial Nerve

- Perform DF/eversion FIRST
- SLR while you maintain DF/Eversion
- Normal response
  - stretching (medial) calf extending to medial ankle, plantar foot
  - ROM: SLR 30-70deg
  - When performed correctly, LE can NOT be raised as far as std SLR

SLR Sensitizers--Common Peroneal Nerve

- Indications: conditions affecting anterolateral leg, ankle and dorsal foot
- PF/Inversion FIRST then SLR
- Cerv Flex = structural differentiation
- Normal response: pulling/stretch anterolateral leg, ankle foot

SLR Sensitizers -Sural Nerve

- Indications:
  - symptoms posterolateral leg, ankle, foot (sprained ankle, S1 radic, cuboid syndrome, peroneal tendonitis)
- DF/Inversion FIRST then SLR
- Cerv Flex = structural differentiation
- Normal response: pulling/stretch lateral ankle, posterolateral calf
  - SLR ROM 30-60 deg

Slump Test

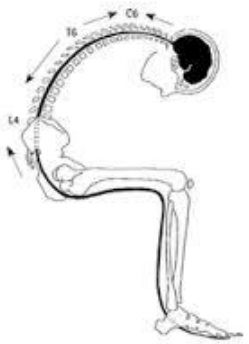
- Assesses the mobility of pain sensitive structures in the vertebral canal and intervertebral foramen (dura mater and root sleeves) and peripheral nerves as a possible source of pt c/o. The test evaluates the limitation of motion and reproduction of symptoms (Maitland)

Slump Test

- Indications:
  - Neck flexion or SLR and its variations are borderline (+)
  - Where the subjective exam suggests the possibility of altered neurodymanics (sitting reading produces leg pain but minor to no symptoms with sitting otherwise)
  - Post surgical pt
  - Symptoms in the absence of joint signs
  - Chronic derangement/dysfunction
  - Symptoms do not fit a normal pain pattern (knee/foot not responding to local treatment)
  - LE mm tears

Slump Test

- Precautions:
  - Irritable pt
  - Unstable discogenic problems where LB flexion may exacerbate a derangement
  - Elderly pt
  - Reproduction of symptoms taking a long time to settle
  - Test which produces cord s/s
  - D/c Test if
    - Dizziness
    - Head pain
    - Reproduction of symptoms



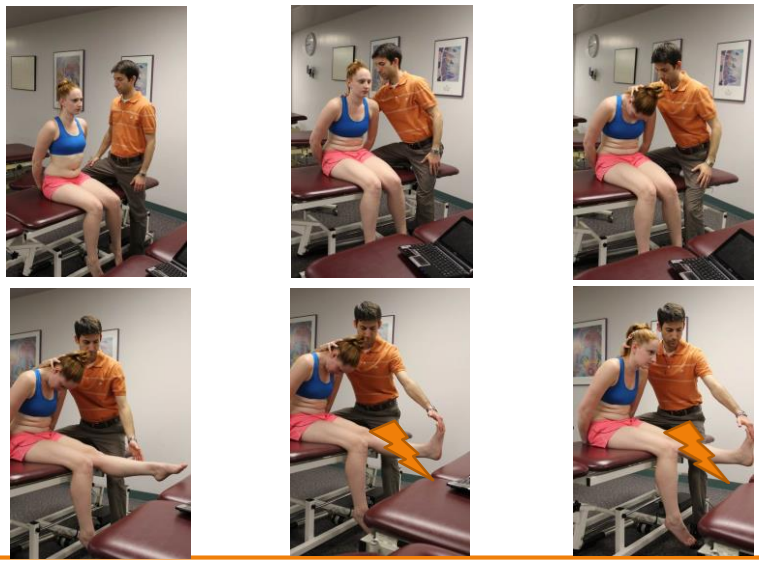
"The sensitivity and specificity of the slump and the straight leg raising tests in patients with lumbar disc herniation."
Journal of Clinical Rheumatology 2008

- Slump
  - Variant of SLR test performed in sitting
  - Series of maneuvers to place sciatic nerve root under increasing tension
  - Applies traction to the nerve roots by incorporating both spinal and hip flexion in combo with the leg raise if negative SLR test
  - Sensitivity .84—greater than SLR b/c of cervical gliding of spinal cord helps to distinguish neural tissue restrictions vs other soft tissue (ie., HS tightness)
  - Traction to all nerve roots

Slump Test--ASSESS at each position

- Pt seated, knees flush against table, sacrum remains vertical
- Hands behind back
- Thoracic flexion
- Cervical flexion (PT hand on occiput to give cue to maintain flex NOT apply overpressure)
- Extend one knee (progress on unaffected LE first)
- Dorsiflex foot of extended knee
- Cervical extension –performed at point in test when symptoms are reproduced to see if pain is relieved or if further LE ext is possible (either is + test finding)

Neurodynamic Testing – Slump Test



(-)

Slump Test—further sensitizing positions

- Can add:
  - Extend other leg into full knee ext, DF (need assistant to perform)
  - Contralateral cervical, thoracic and/or LB Sidebend

Slump Test

- Responses:
  - Normal
    - Pain in region of T9 during trunk/neck flexion
    - Pain behind knee w/knee ext
    - Restriction of ankle DF
    - Dec in symptoms and increase ROM knee ext/ankle DF when releasing neck flex
  - Positive
    - Reproduction of local or referred symptoms (pt c/o)
    - Asymmetrical restriction of movement

Prone Knee Bend

- Indications:
  - Routine test for patients with knee, anterior thigh, hip, anterior groin and upper lumbar symptoms. Assessment of femoral nerve and its branches.
- Method:
  - The patient lies prone, with their head turned toward the testing side.
  - the therapist grasps the lower leg and flexes the knee to a predetermined symptoms response.
  - Use hand on sacrum/finger on SP to monitor for motion

Prone Knee Bend

- Normal response :
  - Asymptomatic, and in some normal there is sensation of pulling or pain in the area of the quadriceps
- Positive Response:
  - The response should be compared to the other side (movement, resistance or reproduction of symptoms)
  - Pain on the unilateral lumbar area, buttock, or posterior thigh may indicate lumbar radiculopathy of L2-L3 nerve roots.

Prone Knee Bend

- Sensitizing additions
  - hip ext, adduction with knee flex (lateral femoral cutaneous)
  - Hip abd, lateral rot, hip ext with knee flex (saphenous nerve)
  - Slump in side lying.

Prone Knee Bend

- Therapist grasps the lower leg and flexes the knee to a predetermined symptoms response.
- Use hand on sacrum/finger on SP to monitor for motion

Prone Knee Bend Variations

- Sensitizing additions
  - Hip ext, adduction with knee flex (lateral femoral cutaneous)
  - Hip ext, lateral rot, hip abd with knee flex (saphenous nerve)

Slump Knee Bend Test

- Believed superior to prone knee bend test in differentiation between symptoms arising from neural vs. non-neural tissues in anterior thigh due to addition of the spine flexion
- In 2011, Trainor et al. looked at the diagnostic value of L4 nerve root compression in conjunction with other levels of nerve root compression through utilization of this test. MRI imaging was used as a gold standard for diagnosis
- Sensitivity: 100%, Specificity: 83%, + predictive value: 67%, negative predictive value: 100%,

Slump Knee Bend

Fig. 2. The slump knee bend neurodynamic test. Reproduced with permission from Claire Molyneux, Senior Physiotherapist, Aintree University Hospitals NHS Foundation Trust.

Slump Knee Bend

- Patient sidelying, slightly "cuddling" the underside leg (but not fully flexing it) with cervical and thoracic spine flexed
- PT stands behind the subject supporting the upper leg to maintain a neutral hip position
- Knee flexed and hip extension to the point of symptoms at the onset of firm resistance.
- Once symptoms are present pt is asked to extend their neck. PT monitors changes in symptoms and resistance to hip movement before ending the test
- Compare to asymptomatic side.

Slump Knee Bend

- Normal Response (negative result)
  - Symptoms of stretching or discomfort on side tested
  - Symptoms are felt in anterior thigh
  - Normal symptoms may decrease in intensity or remain the same when cervical extension is performed
  - ROM and normal symptoms response is same side-to-side
- Abnormal Response (positive result)
  - All or part of the subjects reported symptoms are reproduced or increased during the test
  - Provoked symptoms should diminish when the cervical spine is extended

Predictors for Identifying Patients With Patellofemoral Pain Syndrome Responding to Femoral Nerve Mobilization

- Predictor of immediate efficacy: LBP and positive femoral slump test
- Predictor of pain relief after 6 treatments: immediate efficacy after treatment one + bilateral difference in hip ext angle of FST of > 3°
- Pt laying in SL slump position, PT performs PROM hip ext with pt knee in flexion until a reproduction of soreness. Tension held 2 sec for 3 x 10—treatment duration 6 sessions

Archives of Physical Medicine and Rehabilitation
journal homepage: www.archives-pmr.org
Archives of Physical Medicine and Rehabilitation 2015;96:920-7

Clinical Reasoning

- Are the relationships between the areas on the body chart, the interview, and physical exam consistent? yes
- "Do the "Features Fit" a recognizable clinical pattern?" – If "Yes" – what : _LB disc dysfunction with neural irritability
- **Identify any potential risk factors** (Yellow, Red flags, non MSK involvement, biopsychosocial) None

PICO

- **Patient/Problem Intervention Comparison Outcomes**
- **In patients with neural irritation, does neurodynamic treatment improve low back and LE symptoms?**
- **Assessment of Evidence**

Evidence for Neural Mobilization Efficacy?

- "Neural Mobilization: A Systematic Review of RCT's with an Analysis of Therapeutic Efficacy" JMMT 2008
  - Lack of quantity and quality of available research
  - Limited evidence to support use of neural mobilization
  - More research necessary
- "LBP: Clinical Guidelines Linked to the International Classification of Functioning, Disability and Health from the Ortho Section of the APTA," JOSPT 2012
  - "C rating"
  - Clinicians should consider utilizing lower quarter nerve mobilization to reduce pain and disability in pts with subacute and chronic LBP and radiating LE pain

Effectiveness of Neural Mobilization in the Treatment of a Patient with Lower Extremity Neurogenic Pain: A Single-Case Design

Joshua Cleland, DPT, OCS
Gary C. Hunt, DPT, OCS, CPed
Jessica Palmer, SPT

- 29 y.o female with 2 months of calf pain increased upon sitting, LB Flexion
- Intervention: Neural mobilizations beginning session 4 through14
- Improved pain and LE ROM

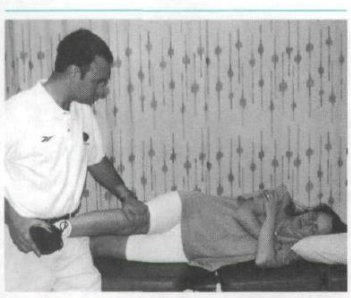


Fig. 2a. Neural mobilization techniques directed at the sciatic continuum in a modified straight-leg-raise position.

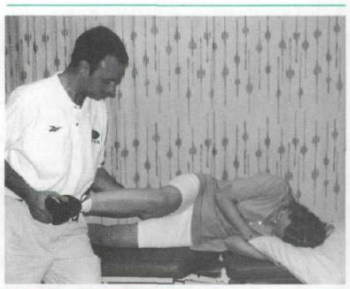


Fig. 2b. Progression of neural mobilizations into a modified slump position.

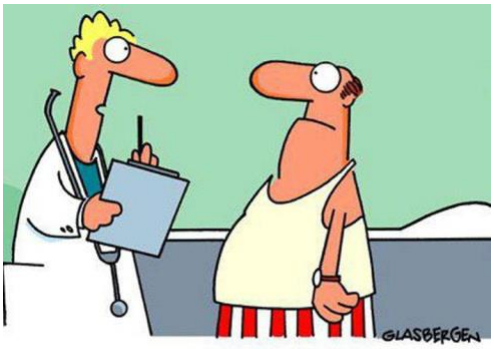
Application of a classification system and description of a combined manual therapy intervention: a case with low back related leg pain

Shannon M. Petersen[1,2], Daphne R. Scott[3]

- Case study of Pt w/chronic LBP, R buttock pain increased w/sitting, dec w/standing/walking, positive slump
- 6 weeks of treatment: manual therapy combined with ND treatment and HEP
- Resolution of symptoms

Associated Factors for Expected Outcome

- Favorable
  - Early intervention
  - Can reduce pain w/standing and eliminate w/SL
  - Age
  - First episode of symptoms
- Unfavorable
  - (+) ANTT
  - Seated job provokes symptoms



"What fits your busy schedule better, exercising one hour a day or being dead 24 hours a day?"

Pattern Recognition

- Subjective
  - MOI: sitting/twisting
  - Pain increased w/sitting, Flex, end of day
  - Pain alleviated w/walking, Ext, laying (NWB)

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Pattern Recognition

- Physical Exam
  - (+) pain with Flex
  - Poor sitting tolerance
  - Improved symptoms with extension
  - (+) slump, SLR

Initial Evaluation Treatment

- Education:
  - Anatomy and positions of Aggs/Ease for disc compression and neural tension
    - Pt will become better historian w/better eval education
  - Healing process and time/prognosis
  - Compliance with attendance, HEP, and activity modification
  - Posture—impact on current dysfunction and correction for work/home

Treatment progression

- First treat patient in positions of tolerance
  - Often begin with SL or supine
- Functional position ND treatment
  - Sitting/standing
  - Recreational activity replication
- Treatment into tension positions
  - Therex
  - Manual therapy
  - Functional retraining

Initial Evaluation Treatment

- Treatment progression

Level 1 – highly irritable

LB treatment

- Static Opening
- Dynamic Opening (gap)

Level 2– low irritability

LB treatment

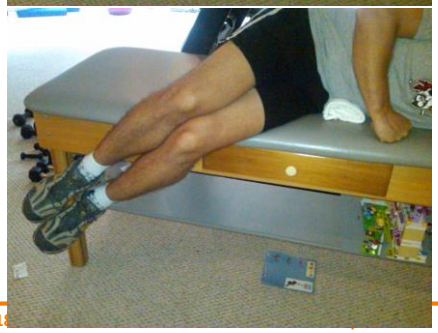
- Static Opening with LE tension position
- Dynamic Opening (gap) with LE tension

Initial ND treatment

- Tension contralateral LE statically then dynamically
- Position contralateral LE in tension then begin moving ipsilateral side into tension

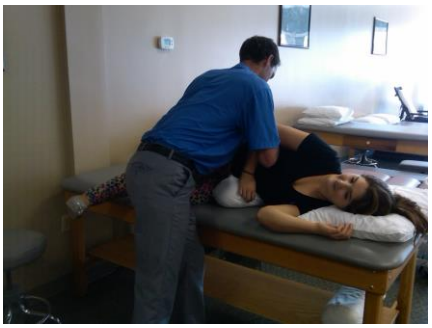
LB Treatment

- Static Opening for R side
  - Contralateral SB to open intervertebral foramina
  - May prescribe for HEP of periodic rest or sleeping position
  - Degree of opening depends on pt tolerance
  - 30-60sec to begin then reassess
  - Can increase SB by adding single/double leg drop over edge of bed



Manual interventions with Neurodynamics

- Dynamic opening-gapping for R side
  - Contralateral SB to open intervertebral foramina
  - Degree of opening depends on pt tolerance
  - 30-60sec to begin then reassess
  - Can increase SB by adding single/double leg drop over edge of bed
  - Large or small amplitude gap at mid to end range



ND Sequence

- Tension Contralateral LE statically
- Ipsilateral can be kept in slack to further desensitize affected side
  - Progress to move ipsilateral side into neutral then tension positions
  - Can prescribe for HEP after 24 hr tolerance post-treatment

Excursion of the Sciatic Nerve During Nerve Mobilization Exercises: An In Vivo Cross-sectional Study Using Dynamic Ultrasound Imaging

- Used US imaging to determine excursion of sciatic nerve during sliders vs tensioners
- 5x greater excursion during slider than tensioner
- Clinical implications: Sliders more indicated in early, irritable stages, tensioners later in preparation for functional or sport-specific return

JOURNAL OF ORTHOPAEDIC & SPORTS PHYSICAL THERAPY | VOLUME 45 | NUMBER 10 | OCTOBER 2015

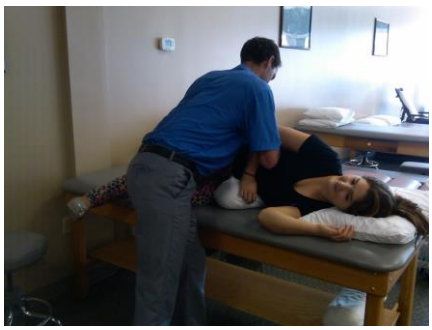
ND Sequence

Supine knee ext slider

- Supine neural slider: supine 90 deg hip flex w/lower leg relaxed in knee flexion and plantar flexion
- Pt supports LE.
- PROM or AROM knee ext to before posterior thigh or LB symptoms.

Tensioner

- Tensioner with dynamic opening
  - Use hip/knee ext and/or DF to tension ipsilateral LE during gap in SL



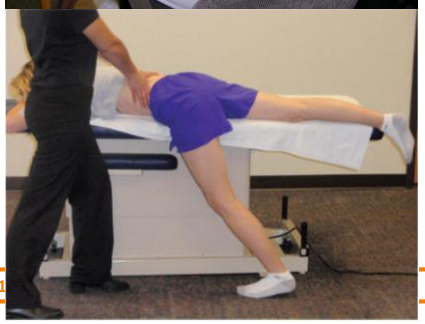
ND Sequence

Supine knee ext tensioner

- Can then have pt add DF position prior to slider to begin tensioner
- Can increase knee ext AROM/PROM BEFORE reproduction of symptoms
- Can further sensitize with contralateral SB

Manual Interventions with Neurodynamics

- Prone R L 5 PA
- Progress to prone with R LE hanging off bed in SLR position
- Start in knee flex and progress to knee ext
- Can also add ipsilateral or contralateral SB or POE position to sensitize/desensitize



Manual interventions with Neurodynamics

- LB PPIVM with SLR
- Can add contralateral SB to further tension

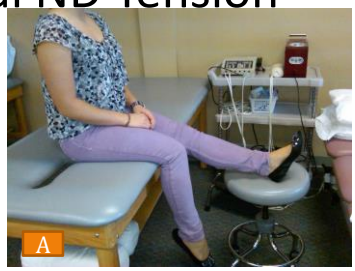
Manual Interventions with Neurodynamics

Long sitting manubriosternal mob

- "AP of spine" by pressure through sternum
- Promotes dural stretch
- Begin in erect sitting w/knees propped in flex and progress to slump with cerv flexion, knee ext, DF

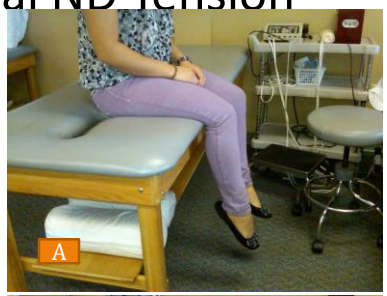
Seated Slump Therex Progression Using Contralateral ND Tension

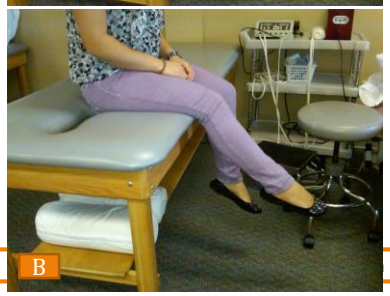
- A. Knee ext, DF left (loading contralateral side), PF, knee flex right (unloading ipsilateral side)
- B. Knee ext, DF left (loading contralateral side), maintain PF but begin moving into knee ext for nerve sliding on right (beginning to load ipsilateral side)



Seated Slump Therex Progression Using Contralateral ND Tension

- A. Knee flex, PF left (unloaded contralateral side), PF, knee flex right (unloaded ipsilateral side)
- B. Knee flex, PF left (unloaded contralateral side), maintain PF but begin moving into knee ext for nerve sliding on right (beginning to load ipsilateral side w/o unloading of tensioned contralateral side)





Seated Slump Therex Progression Using Contralateral ND Tension

- pt now tolerates seated neutral with cervical flexion—increases dural tension
- A. Knee flex, PF left (unloaded contralateral side), PF, knee flex right (unloading ipsilateral side)
- B. Knee flex, DF left (unloaded contralateral side), maintain PF but begin moving into knee ext for nerve sliding on right (loading ipsilateral side)

Seated Slump Therex Progression Using Contralateral ND Tension

- bilateral long sitting produces more dural stretch---significant tension both sides
- A. Hip flex (on pillow), knee ext, DF left (loading contralateral side), PF, knee flex right (unloading ipsilateral side)
- B. Hip neutral, knee ext, DF left (less loading contralateral side), knee flex, PF right (unloaded ipsilateral side)

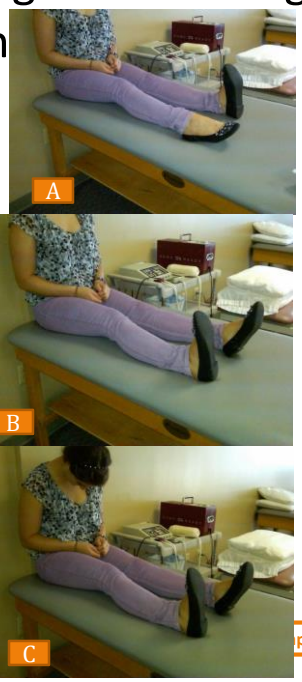
Seated Slump Therex Progression Using Contralateral ND Tension

A. DF left (loading contralateral side), PF right (unloading ipsilateral side)

B. PF left (unloaded contralateral side), DF right (loading ipsilateral side)

C. PF left (unloaded contralateral side), DF right (loading ipsilateral side)

**added cervical flexion to add more tension to dural stretch



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Original article

Slump stretching in the management of non-radicular low back pain: A pilot clinical trial ☆

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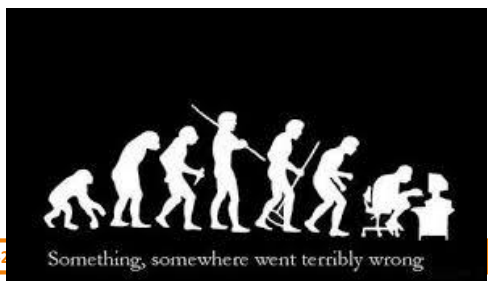


Slump stretching in the management of non-radicular low back pain: A pilot clinical trial ☆

Joshua A. Cleland[a,b,*], John D. Childs[c], Jessica A. Palmer[d], Sarah Eberhart

- Control Gp—LB mobilization + Exercise
- Experimental Gp– Slump stretch + control gp treatment
- Significant improvement in disability rating, pain scale and centralization of symptoms
- Decreased symptom intensity in 5-12 treatments

Slump Stretch Protocol

- Slump stretch
  - PT provides overpressure to cervical flexion to the point of symptoms with patient's feet vs wall at 0 deg DF
  - 5 x 30 sec
  - Slump stretch HEP
  - Patient in same position as above but applies overpressure themselves w/UE until the reproduction of symptoms
  - 2 x 30 sec

Fig. 3. Slump stretching technique performed as the patient's home exercise program.

Effect of slump stretching versus lumbar mobilization with exercise in subjects with non-radicular low back pain: a randomized clinical trial

Amit Vinayak Nagrale, Shubhangi Pandurang Patil, Rita Amarchand Gandhi, Ken Learman

- 60 patients w/non-radicular LBP w/o neuro signs
- Control Gp—LB mobilization + Therex
- Experimental Gp– Slump Stretch + Control Gp treatment
- Significant improvement in Experimental Gp ODI, FABQ and pain scale

Slump Stretch Protocol

Slump stretch

- PT provides overpressure to cervical flexion to the point of symptoms with patient's feet vs wall at 0 deg DF
- 5 x 30 sec

Slump stretch HEP

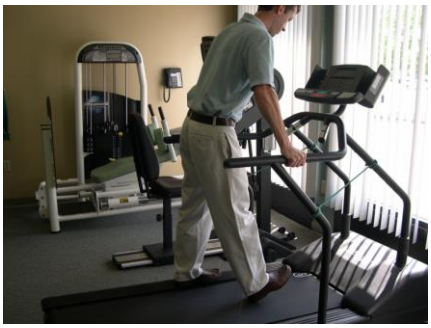
- Patient in same position as above but applies overpressure themselves w/UE until the reproduction of symptoms
- 2 x 30 sec

Figure 1 Slump stretch technique.

Figure 2 Self-slump stretching home exercise program.

Functional position ND sequence

- TM PWB stance/swing slider



- If WB increases symptoms but neural gliding is tolerated in erect posture, pt can stand on LLE at side of treadmill w/bilateral UE support.
- Use minimal WB on R LE to mimic stance and swing on R LE in ROM prior to LE symptoms
- "functional position" neural slider
- Progress to more WB and larger AROM symptom dependent

General Guidelines to ND Treatment

- The technique should be well away from the symptom area
- Treatment should be non-provoking initially.
- Can use large or small grade oscillations based on pt presentation and response
- Maximal relaxation of the patient, and the painful areas will allow better nerve movement
- If the technique starts to irritate the pain, either reduce the amplitude/range/speed of the technique
- REASSESS after each technique as nerves can become irritable quickly

ND Progression

- Neural sliders or tensioning repetitions may be as few as 5-10 initially but can increase to repetitions for several minutes
- Preferred to perform a sequence of gentle oscillations, for 20 seconds and then repeat

ND Progression

- Consider increasing the amplitude and taking the technique further into resistance.
- Repeat the technique but alter to increase degree of tension by addition of the sensitizing components.
- **Give 24 hours to see how pts respond prior to HEP or progression of treatment**

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SLR Variations with Treatment

- Add sensitizing/desensitizing positions based on area of symptoms and irritability
- Examples:
  - Knee ext with hip at 90 deg flex in hip adduction
  - SL SLR with roll under ipsilateral or contralateral side
  - HS stretch in doorway while performing STM on HS
  - FMP squat with STM to calf
  - Mobilize fibular head in SL 90 deg hip flex, partial knee ext
  - Central or unilateral segment PA with pt involved LE off side of table in modified SLR position

Slump Variations with Treatment

- Alternating neck and trunk position to move into or out of ANTT
- Slump variations in SL
- Neck or DF in long sitting: unilat or bilat knee ext and DF. Can change trunk or neck positions, add ER or Abd to desenstize
- Thoracic flexion in long sitting, feet vs wall for DF or active DF
- Combine PKB on one side in SL

Neurodynamic Quick Tests

- Functional tests which are easy to assess
- Assist in focusing objective eval and working hypothesis
- Use a functional aggravating factor

Neurodynamic Quick Tests

- Examples
  - LB flexion increases calf pain: add cerv extension to desensitize ANTT
  - LB SB away causes LE pain: add cerv SB towards to desensitize. Or if LB SB causes no symptoms, add cerv SB away to sensitize
  - Sitting w/RLE crossed over left inc R trochanteric pain: add cerv flex or trunk flex. Reverse sequence of test
  - Squatting: with trunk flex vs extension. Add cerv flex or SB away