Providing practical solutions for clinical therapists

www.neurodynamicsolutions.com
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About Neurodynamic Solutions (NDS)

Background
Neurodynamic Solutions (NDS) is the teaching entity founded by Michael Shacklock. It was started with the express purpose of offering practical clinical solutions for therapists with an interest in neuromusculoskeletal problems. The emphasis is on clinical neurodynamics for neuromusculoskeletal problems in a way which clarifies and demystifies neurodynamics and makes the subject as clinically applied as possible.

Objectives
Offer practical clinical solutions for therapists who treat patients with musculoskeletal problems with a neural component
Include the most up-to-date research and clinical information
Offer a systematic method of application of neurodynamics
Foster further development in clinical neurodynamics

Resources
Free registration
Web site - neurodynamicsolutions.com
Courses - upper and lower quarters
Newsletters - clinical solutions, new updates in research, conferences announcements, books and other resources, web links - other physiotherapy/physical therapy and educational groups, search engines and physical therapy data bases

AAOMPT Course Manual
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NEURODYNAMIC SOLUTIONS (NDS) COURSES

Courses in clinical neurodynamics as presented in Michael Shacklock’s book are available worldwide. If you are interested in hosting or attending a workshop, seminar or conference event in neurodynamics do contact Neurodynamic Solutions (NDS).

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Michael Shacklock graduated as a physiotherapist from the Auckland School of Health Sciences in 1980. During his undergraduate training, he quickly developed an interest in manual therapy and has pursued this interest throughout his career. He worked in public hospitals and private practices for several years in New Zealand before traveling to Adelaide, South Australia in 1985, to take part in post-graduate study. In 1989, he completed a Graduate Diploma in Advanced Manipulative Therapy at the University of South Australia and converted this to a Master of Applied Science in 1993. He has taught internationally for over 20 years and has given numerous keynote and invited presentations around the world. His Masters thesis was on the effect of order of movement on the peroneal neurodynamic test, in which he discovered the concept of neurodynamic sequencing. He proposed the concept of neurodynamics in 1995 in the journal *Physiotherapy*. Since then he has studied neural mechanics and pain physiology, performing research and writing a number of publications on the subject. Michael edited the book *Moving in on Pain* and has featured as an invited contributor for various journals such as *Manual Therapy*, *New Zealand Journal of Physiotherapy* and the *Australian Journal of Physiotherapy*. Michael’s most recent publications consist of his new book *Clinical Neurodynamics*, which became an international best-seller and for which he received a Fellow of the Australian College of Physiotherapists by original contribution by monograph. His most recent publication is the book, *Biomechanics of the Nervous System: Breig revisited*. Michael’s recent area of investigation has been the in vivo imaging of mechanical function of the nervous system and cadaver observations of lumbosacral nerve root movement. He is a multi-award winning researcher, his most recent being a collaborator and mentor in the Young Investigator of the Year awards, won by Marinko Rade, for the Finnish Spine Society (2013) and the International Society for the Study of the Lumbar Spine 2014 for validating Michael Shacklock’s proposal of spinal cord movement with the unilateral and bilateral straight leg raise.

Michael Shacklock teaches Clinical Neurodynamics internationally. His current positions are founding director of Neurodynamic Solutions (NDS) and he is a member of the International Advisory Board and a reviewer for *Manual Therapy*.

**Some Publications**

- Shacklock M 1995 Moving in on Pain, Butterworth-Heinemann, Sydney

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After much study and investigation over the last 10 years, Michael Shacklock’s book is about a new system of musculoskeletal treatment for patients whose musculoskeletal problem has a neural component. The book takes the therapist from neural tension to neurodynamics. Key problems with neural tension treatments in the past have been the risk of provocation of symptoms, the method of diagnosis and treatment has been unclear and there has not been a systematic and methodical approach to diagnosis and selection and progression of treatment techniques.

In this international best-seller, Michael demystifies how the nervous system moves and can cause problems, provides a new systematic approach to prevent provocation of symptoms yet still provide a beneficial effect and how to select advanced techniques ranging from those for the very restricted patient to the athlete.

Key Features

- new diagnostic and treatment techniques
- over 200 diagrams and illustrations of techniques
- new movement diagram to help the clinician link musculoskeletal and neural functions
- new system for technique progression from restricted to highly mobile patients
- a method of integrating neural and musculoskeletal techniques in diagnosis and treatment
- CD-ROM of nerves and musculoskeletal tissues moving in real time to illustrate normal and abnormal situations and the importance of the interdependence of the musculoskeletal and neural systems

Purchase on the internet

Web: neurodynamicsolutions.com
Click: books
Click: clinical neurodynamics
AAOMPT NDS One Day Workshop Aims

Improve/develop:

- **manual** and **clinical reasoning** skills, specifically related to neurodynamics

- abilities in **diagnosis** and **interpretation** of neurodynamic testing and musculoskeletal relationships

- **technique selection** and **performance**

Please Note

Participants are responsible for their own well being on this course. It is recommended that participants decline to have any manoeuvres performed on them if the participant may react with undue pain or suffering, have a condition which might influence their ability to tolerate any manoeuvres or predispose to the development of subsequent pain or suffering.

Participants are under no obligation to have a manoeuvre performed on them and may freely decline.
Section 2

Neurodynamics
Audiovisual Presentation
NO RECORDING!

OK!!

AAOMPT One Day CR Neurodynamics Workshop

Improve/Develop:
- manual and clinical reasoning skills, specifically related to neurodynamics
- abilities in diagnosis and interpretation of neurodynamic testing and musculoskeletal relationships
- technique selection and performance

Problems with ‘Tension’

Makes us think of tightness in nervous system
Corollary is ‘stretch’

Stretch:
- can cause injury
- can increase pain
- often ineffective
- caused therapists to abandon the approach

Concept of Neurodynamics

Many other aspects were being omitted:
- sliding, pressure
- physiology
- intraneural blood flow
- mechanosensitivity
- inflammation in neural tissues

Challenge the word ‘tension’
Concept of Neurodynamics (cont.)

Must link mechanics and physiology and function of the musculoskeletal system
Shacklock 1995 Physiotherapy

Clinical Neurodynamics Definition - clinical application of mechanics and physiology of the nervous system as they relate to each other and are integrated with musculoskeletal function

Benefits of Clinical Neurodynamics

Safer - less stretching of nerves
Links diagnosis and treatment to causal mechanisms
Integrates neural aspects with the musculoskeletal system
Systematic

General Neurodynamics

Definition
Principles of clinical neurodynamics that apply to the whole body no matter what region. They are therefore general or universal principles.

Three Part System
**Nervous System Primary Functions**

**Withstand tension**
- 18%-22% elongation before failure
- varies between individuals and between specific nerves

**Sliding - longitudinal**
Longitudinal sliding prevents excessive tension.

**Sliding - transverse**
Transverse movement of the median nerve at the wrist
1-5 mm
Nakamichi and Takimoto 1995
Greening et al 1999

**Compression**
Compression of nerve during daily movement
Similar events occur with joints and fascia
Three Ways to Move Nerves

1. Move the joint
   Force direction is away from the joint.
   DIFFERENT FROM direction of movement.

2. Move the innervated tissues
   Other nerves:
   - ulnar
   - median
   - motor branch (median)
   - digital
   - axillary
   - musculocutaneous

3. Move the interfacing soft tissues
   - muscle
   - fascia

The Nervous System is a Continuum
Breig 1978

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Structural Differentiation

Definition
When the therapist moves the relevant neural structures (remotely) without moving the adjacent musculoskeletal structures.

The nervous system is emphasized.

Structural Differentiation (UQ)
Wrist symptoms - contralateral lateral flexion
Structural differentiation is used in ALL neurodynamic tests in diagnosis.

Transmission of forces along the system:
- Type of neural effects during neurodynamic technique:
  - early in movement - taking up slack
  - mid range - sliding effects
  - end range - tension effects
- Charnley (1951), McLellan and Swash (1976), Wright et al (1996)

Gives Us Progressions
- Early in movement: just apply small force to nerve without producing significant movement
- Mid range: produce sliding
- End range: apply tension

Convergence
- Nerves move toward the joint at which tension is being applied.

Neurodynamic Sequencing
- Summary:
  - The sequence of movements influences the location of symptoms.
  - More symptoms at the area that is moved first and most strongly (distal)
  - e.g. foot - peroneal nerve (Shacklock 1989)
  - upper limb (Zorn, Shacklock & Trott 1995)
Neurodynamic Sequencing

Tsai 1995 - cadaver study on ulnar nerve

- proximal-to-distal sequence
- distal-to-proximal sequence
- elbow first sequence

Greater strain in the ulnar nerve at the elbow with the elbow first sequence (approx. 20%) Intraneural tension reflected this change.

Neurodynamic Sequencing

General principles

- Sequence of movements influences local tension and strain in the neural tissues.
- Greater strain in nerves occurs where the force is applied first and most strongly.
- This translates into changes in symptom responses with human subjects.

TECHNIQUE IS IMPORTANT!

Neurodynamic Sequencing - progressions

Sequence

Protective - remote sequence

Note: No hand or finger movement. Differentiation is the "off switch".

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31 32 33 34 35 36
2. Sliders
The nerves slide toward the site where force (elongation) is initiated - 'down the tension gradient'

Distal slider  Proximal slider

3. Tensioners

4. Focused Sequence - more Specific/localised
Start at the relevant location

Wrist:
- Wrist extension
- Elbow extension
- Shoulder abduction
- Lateral flexion

Physiology and Movement

Elongation
- Elongation produces changes in blood vessel function
- 8% - intraneural veins start getting blocked
- 15% - all blood flow through nerve is blocked
- Lundborg and Rydevik (1973)

Compression
- 30-50 mmHg reduces venous flow from nerve
- Over one hour and the nerve fails
  (Gelberman et al 1983)
- Clinical pressures can reach 240 mmHg
  (Wemer et al 1985)
Physiology and Movement (cont.)

Mechanosensitivity

How easily nerves are activated when subjected to mechanical force.

Mechanosensitivity (cont.)

Is tested (evaluated) with:
- neurodynamic tests
- palpation
- passive movements
- active movements

NEURODYNAMIC TESTS

Neuropathodynamics
Neurodynamic Test

Definition

A series of body movements that produces mechanical and physiological events in the nervous system according to the movements of the test.

Specific Neurodynamics

Definition

Local effects of body movement on the nervous system in a way that is specific to each region.

Eg. differences between dynamics of the median, ulnar and radial nerves

Mechanical interface - spinal canal

Intervertebral Foramen

Neural Tissues

a. Extension
   - shorter and compressed
b. Flexion
   - tissues longer and slide

(Breg 1978)
Clinical Uses of Flexion/Extension

Diagnosis of mechanical interface component
- reduced flexion - reduced opening dysfunction
- reduced extension - reduced closing dysfunction

Treatment is directed at the specific dysfunction:
- improve opening or closing, depending the problem

Lateral Flexion

Neural tissues on the convex side are tightened

Breig 1978
© 2007 Neurodynamic Solutions

Application of Lateral Movements

Sensitizing movements
- contralateral lateral flexion
- contralateral lateral glide

Desensitizing (off-loading) movements
- ipsilateral lateral flexion
- ipsilateral lateral glide

Contralateral Neurodynamic Tests

Shacklock 2005 Elsevier

Contralateral MNT1 (CMNT1)

96-97% of young asymptomatic subjects show a change in symptoms with the MNT1 with the CMNT1:
- 62% show a decrease
- 33% show no change
- approx. 5% show increase
Elvey 1973, Rubenach 1985

CMNT1 (cont.)

The CMNT1 often reduces tension in the nerve roots:
- can be used to off-load the nerve roots in the cervical spine
Technical is important:
- maintain scapular position and pressure constant
- body and limb positions must be accurate
CMNT1 (cont.)

Can:
- be used to reduce the power of a technique
- itself be progressed to higher or lower levels
- forms part of the progressional system of clinical neurodynamics

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System of technique selection
Should I do a neurological examination?
Planning Examination and Treatment

How extensive should it be?

General Points

Confusion exists about how to select examination and treatment techniques

- how strongly should a neurodynamic test be performed?
- how far into a provoking movement should a test be taken?

There is a spectrum of patient problems ranging from the very sensitive to the athletic which systematic treatment can take into account

- which neurodynamic sequence should be used?
- sliding versus tension treatments
- interface versus neural treatments
- standard tests in evaluation/treatment or limited or extensive/sensitised techniques

Decisions on the extent and type of examination are influenced by many clinical factors that need clarification.

Below is a three tier system of deciding on the extent of the examination in the planning of neurodynamic testing. Naturally, not all criteria will occur simultaneously in the same patient and it is the role of the practitioner to choose the most appropriate elements in deciding on the extent of the examination.

![General System of Technique Selection (diagnosis and treatment)](image-url)
Level Zero – Neurodynamic Testing Contraindicated

Severe pain
Psychological influences
Legal problems
Highly unstable condition, worsening rapidly and other priorities take precedence

Level 1 - Limited

Description

This level of examination is designed to open new and safer avenues for assessment and treatment in the patient with irritable symptoms or a pathology through refined testing.

Previously this has not been the case because, in the presence of risk factors, therapists have generally neglected the neural component.

Safety is the primary concern.

Indications

When pain that is easily provoked and takes a long time to settle after movement. This relates to Maitland’s concept of irritability in which irritable problems are treated more gently and with greater caution than non-irritable problems (Maitland 1986).

Severe pain is present, a complete neurodynamic assessment may not be appropriate for ethical and safety reasons.

Latent pain – when the patient’s pain develops a long time after physical testing. Latency carries risk because adequate warning of an imminent increase in symptoms does not occur at the time of testing.

Pathology is present either in the nervous system or the mechanical interface eg. a severe disc bulge or stenosed lateral recess in which pressure on the nerve root might be elevated and the excursion of the nerve root may be limited.

Neurological deficit may necessitate a level 1 examination so as not to provoke neural irritation or damage.

When a lasting increase in neurological symptoms is possible with neurodynamic testing.

Progressive worsening prior to physical examination.

Uncertain that the nervous system will tolerate standard testing (level 2 examination). If performance of a level 1 examination is found to be safe and does not reveal sufficient information, then the therapist may progress carefully toward a level 2 examination by gradually including more features of a level 2 technique.
Method (General Points)

Some of the components of a neurodynamic test may be omitted so that only minimal forces are applied to the nervous system.

It will also be necessary to modify the sequence of movements (eg. remote).

The therapist performs the usual neurodynamic tests and other mechanical tests for the musculoskeletal structures separately ie. simultaneous testing of the nervous system, interface and innervated tissues is avoided.

Restricted to evoking first onset of symptoms once only, if possible

Full range of motion is often not be achieved

The level 1 examination can provide sufficient information about the problem, particularly whether a neural component exists.

Structural differentiation is still performed, however, it takes a modified form.

Modified Structural Differentiation

Differentiating tension movement is performed prior to the application of any other test movements. The rest of the level 1 test is performed so that, at the first onset of symptoms, the differentiating movement can be released to produce a reduction in symptoms. This is instead of performing a differentiating movement that increases tension at the end of the neurodynamic test and so prevents further provocation of symptoms.

**Structural differentiation becomes the 'off switch'.**

Clinical Example: irritable wrist problem

- contralateral lateral flexion
- shoulder abduction
- elbow extension
- structural differentiation (off-switch) - neck back to neutral position

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Level 2 - Standard

Description
Standard tests are used
Interface, neural and innervated tissues are tested/treated separately
Neurodynamic tests are performed to a comfortable production of symptoms only.
May be, but not necessarily, taken to end range.

Indications
The problem is not particularly irritable
Neurological symptoms are absent, or are only a minor part of the condition, and these neurological symptoms are not easily provoked
The problem is reasonably stable and is certainly not deteriorating rapidly
The pain is not severe at the time of examination, neither is there severe latency in terms of symptom provocation.

Method
The nervous system is effectively put through all its normal paces, but without combining neural tests with musculoskeletal ones. The test movements should not evoke excessive pain, neurological symptoms or go into a great deal of resistance.
Standard neurodynamic tests are used
Neural and musculoskeletal structures are examined separately
Movement into some symptoms is acceptable, as long as they are not severe and settle down immediately after the test
A degree of resistance may be encountered, however, it should not be strong
Full range of movement may be reached but this is not essential.

Level 3 – Advanced

General Description
Testing of the nervous system is more extensive than the previous levels.
Specificity and sensitivity are the focus and this is based heavily on the neuropathodynamic mechanisms.
Neural structures can be tested in relation to the musculoskeletal tissues - more sensitive.

Indications

Level 2 (standard) examination tests are normal, or do not reveal sufficient useful information, and the clinician wishes to investigate the problem more extensively

The problem is stable

When the patient’s clinical pain is difficult to evoke

When there is no evidence of pathology that might adversely affect the nervous system

No neurological abnormalities eg. loss of conduction are present

High expectations in physical function.

In any patient from whom sufficient information has been gained by the execution of a level 1 or 2 examination, the level 3 examination is unnecessary and contraindicated.

Level/type 3a. Neurodynamically Sensitised

Definition

More neural tension is added to the standard neurodynamic test through the addition of sensitising movements.

Standard test but “more-of-the-same’ technique”

- contralateral lateral flexion
- scapular depression
- shoulder horizontal extension

Method

The level 2 examination is performed prior to executing one at level 3. This is to be sure that the nervous system can cope with such testing.

Only the sensitizing movements of the standard neurodynamic test are added to the standard test.

Level/type 3b. Neurodynamic Sequencing (Localised)

Description

Local sequence - movements start locally and become progressively more remote.

A particular part of the nervous system is emphasized.
Level/type 3c. Multistructural

Description

Neural structures are tested in combination with tests for musculoskeletal structures.

Generally used in the person with high expectations in terms of human function in which minor mechanical problems will provoke symptoms more easily than in patients whose needs are less extensive.

Often athletes, sports people and persons who work in occupational settings where high demands are a feature of their activities.

Method

Many movements and structures can be used.

Interface, neural and innervated tissues can be moved at the same time eg. opener and neural, with some innervated tissues testing also.

Neurodynamic sequencing is modified to suit the patient’s specific pathodynamics.

Level/type 3d. Symptomatic Position or Movement

Description

Neural structures are tested in the position or movement that reproduces the patient’s symptoms. This makes the manoeuvre relevant to the patient and offers an infinite number of opportunities to test the neural and musculoskeletal systems together.

Also may be performed after or during a symptomatic activity eg. throwing, writing or working at a factory.

Method

The patient nominates their provoking symptomatic position/movement and performs that particular manoeuvre.

Symptoms are then differentiated with remote movements.

Neurodynamic sequencing can be modified to suit the patient’s needs eg. they might need to move into the relevant position in a certain way.

Differentiation of shoulder pain during a throwing action (eg. wrist movements)
Practical Exercises

Perform the following examination for:

- irritable wrist problem - proximal-to-distal sequence (level 1)
- minor wrist problem - distal-to-proximal sequence (level/type 3b)
- irritable neck problem - distal-to-proximal sequence (level 1)
- minor neck problem - proximal-to-distal sequence (level/type 3b)

Should I Do a Neurological Examination?

A neurological examination should be performed:

- when a neural component is suspected
- before and after significant neurodynamic techniques in treatment eg. level 3a
- making sure that a neurological deficit has not developed at the end of a course of treatment
- neurological deficit that was present in the first instance is changing for better or worse
- reassess progress when neurological problem is detected
- when performing contralateral neurodynamic movements - may have to do assess the effect of these movements to be assured that the contralateral technique has not produced any problems
- may be indicated when starting closer techniques for the first time after doing openers
- if in doubt, a neurological examination should always be performed.
Section 4

Diagnosis with Neurodynamic Tests
Lecture and practical/lab session

Classification of responses
Interpretation of neurodynamic tests
Practise testing
Diagnosis with Neurodynamic Tests

Interpretation of Neurodynamic Tests

Potential Sources of symptoms

- Axons in the nerve
- Connective tissues in the nerve (nervi nervorum)
- Blood vessels in or around the nerve
- Muscles
- Joints
- Fascia

Therefore structural differentiation manoeuvres are essential

Structural Differentiation

The first distinction to make is whether the nervous system is involved because it affects the next chain of events with the way we reason through the examination and treatment.

Structural differentiation is used to make a distinction between neural and non-neural structures and is an essential part of neurodynamic testing. As a reminder, it is when the nerves in the problem area are moved without moving the musculoskeletal tissues. Therefore, if the symptoms change with the differentiating manoeuvre, the symptoms are inferred to be neurogenic. In the non-neural response, the symptoms do not change with the differentiating movement. The validity of structural differentiation has not been definitively proven but there is good evidence that, in some cases, it is a valid way of testing nerves.

Here is an example of structural differentiation:

eg. Forearm symptoms with the MNT1. Neural or musculoskeletal?

Change the tension in the nerves with side bending of the neck and, if the symptoms also change, the symptoms are likely to be neural. If they do not, then they are likely to be non-neural (ie. from muscles, joint or fascia). To differentiate symptoms in the neck or shoulder, you would use wrist movements.

The next section on classification of responses challenges some of our old concepts of positivity.

Classification of Responses

Problems exist with the classification of symptoms responses with neurodynamic tests because of the many possible types of responses that can
occur and what each means. Here is a suggested classification of responses and a distinction between them must be made for clinical interventions to be well-founded.

Diagnostic/Clinical Pathway
**RELEVANT?**

NO
Does not relate to problem

YES
Relates to problem

**CAUSE**

Complete Evaluation

Diagnostic Category
- red flags
- muscle
- disc
- joint
- neuropathy
- interface
- tension
- sliding

**TREATMENT?**

Elimination of contraindications → NO

Is this my professional territory? → YES

**TECHNIQUE SELECTION**

Diagnostic Category
Level/type of the patient:
1
2
3a, b, c, d, e

**PROGRESSIONS**
Musculoskeletal Response

A musculoskeletal response does not change when a differentiating movement is performed. Neurodynamic tests can produce this kind of response. In which case the neural tissues are not likely to be the source of symptoms.

Normal Neural Responses

The ULNTs are very sensitive tests because they are neurogenic in normal subjects (Kenneally et al 1988). So here are some crucial questions.

Q: What does a positive test mean if they are positive in normals?

A: It is normal for a test to produce a neurogenic response. Therefore, we must now distinguish between normal neurogenic and abnormal neurogenic responses in our patients.

- Are differentiated to be neural
- Are similar in location and range of movement and quality of symptoms to those in normal subjects
- Reasonably symmetrical in site and quality of symptoms
- Reasonably symmetrical in range of motion and behaviour of resistance
- Does not reproduce the clinical symptoms

Abnormal Neurogenic Responses (neuropathic)

- Are differentiated to be neural with structural differentiation
- Are different from those in normal subjects
- Show reduced range of movement compared with the unaffected side
- Show increased resistance compared with the unaffected side
- The location or quality of symptoms can be different from normal or unaffected side

A. Overt Abnormal Response

- Structural differentiation gives a neural result.
- The test reproduces the patient’s symptoms
- The range of motion may be reduced.
B. Covert Abnormal Response

Is differentiated to be neural
Evokes abnormal symptoms but it:
Does not reproduce the patient’s clinical pain
May be asymmetrical in range, resistance pattern or distribution of symptoms
May be a “comparable sign” worth treating.

The most important thing is to determine the relevance of the response. In the symptomatic patient, it could be a subtle problem that needs treatment.

Or, in the asymptomatic person, the response could be a hidden subclinical abnormality, or even a variation on normal for that individual. Matching this response with the patient problem is a key aspect of interpreting responses to neurodynamic tests.

eg. a patient complains of forearm pain when working with computers. A cramping ache is evoked by the MNT1 in the region of the problem but it is not the sharp pain like it is with using a computer. The clinical pain is not reproduced but something abnormal is evoked. It is differentiated to be neural with neck contralateral lateral flexion and the range of elbow extension is reduced by several degrees compared with the normal side. The supination component of the test is tight compared with the other side, and this loosens with releasing neck contralateral lateral flexion. These physical signs could be relevant and to miss them would leave the patient without the option of potentially effective treatment.

What Is a Positive Test and What Does It Mean?

Get away from using the term positive because tests are neurogenic (positive) in normal subjects. The NDTs are sometimes so sensitive that an ordinary neurogenic response does not necessarily indicate an abnormality. So I suggest that you do not use the term “positive”.

Use the terms - “normal neurogenic” or “abnormal neurogenic” (neuropathic) and then categorise what type of abnormal neurogenic response it is.

An abnormal neurogenic test does not tell you what exactly is wrong. For more discussion see (Shacklock 1996).

Practical Application - exercises in diagnosis

Tasks:

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Classify the category of response in your partner(s) for the MNT1, RNT and/or MNT2 and UNT.

Remember all the details with physical examination that you practised earlier. Eg. patient position, hand holds, landmarks, slow and gentle, feel for resistance to movement, communicate about where the symptoms are, do structural differentiation etc.

Please do NOT obtain a history from your colleague prior to testing. However, naturally, they are free to decline from being a subject for testing for any reason.

Do the test slowly and gently.

AIM: see if you can identify a neurodynamic abnormality without prior knowledge of your colleague’s history.

In the event that you find an abnormality, you may be interested in taking a brief history to understand the significance of the subject’s response.

Analysis of Test Responses

Once you have decided that the test is positive (to structural differentiation), do the following:

Are those the symptoms you have had before (or partly)?
“YES” - overt abnormal response
“NO” perform stage 2.

Is the response similar to the known normal response?
Are the:
- ranges of motion and tissue resistance normal?
- location and distribution, type of symptoms (stretch etc) normal?
“YES” - normal positive test
“NO” - covert abnormal response (tighter than normal, range of motion reduced, symptoms spread outside the normal area).

1. Not sure - compare with contralateral side.

   NOTE: Any variable used in classifying the response must be positive to structural differentiation.

2. Is it Relevant?
   You can have any type of response (overt, covert, normal) being relevant or irrelevant and this depends on how it relates to the patient’s current problem.

   Relevant
   - reproduces the patient’s current clinical pain - overt abnormal
   - is tighter than normal
   - the symptoms spread further than normal
   - this is different from the asymptomatic side
   - the difference is in the right location for the patient problem
Irrelevant
- relates to an old problem that is no longer symptomatic
- anomalous response that is symmetrical eg. bilateral tightness
- normally tight for that person and is symmetrical
- may have an anatomical anomaly that is not relevant

It is possible that not all nerve problems hurt (Neary et al 1975).

Relationship of NDTs to the Cause

An abnormal neurodynamic test does not establish the cause. This is ascertained in the entirety of the evaluation process and involves subjective and physical examinations, medical and radiological tests etc.

Therefore, the main thing that an abnormal neurodynamic test offers is that fact that something in the nervous system is wrong and the cause must be established.

Possible causes of an abnormal neurodynamic test:
- Pancoast tumour and malignancies
- osteophytes
- disc bulges
- swollen joints and tendon sheaths
- ganglia
- myotendinous and nervous system anomalies
- neuritis
- nerve compression
- joint movement dysfunctions.

Therefore it is imperative that NDTs are only used as an indicator that something is wrong.

An abnormal neurodynamic test means that the neural tissues may be mechanosensitive or contain movement impairment for which the cause must be established.
MNT1 - Median Neurodynamic Test 1

**Patient position** - supine, shoulder flush with the edge of the couch, as little abduction as possible, no pillow

Explanation to the patient

Practise lateral flexion

**Hand holds** - close hand sits on bed above the shoulder, using knuckles as a fulcrum. Lean on that hand with a straight elbow. Other hand holds patient’s hand with a pistol grip

1. **Starting position** - arm down by side, elbow at 90°, neutral wrist position

Make your move: be slow and gentle
2. Glenohumeral abduction/external rotation - up to approx. 90-110° (in frontal plane, stop shoulder from elevating). DO NOT DEPRESS THE SCAPULA.

3. Supination of forearm/wrist and finger extension

4. Elbow extension - to point decided on prior to testing - assess the symptom response and physical behaviour through the movement
5. **Structural differentiation - decided by where the symptoms occur**

- Proximal symptoms - use the wrist
- Distal symptoms - use the neck

**Notes on Structural Differentiation**

- Only ask about WHERE the symptoms are
- Use this information to decide on and perform the structural differentiation manoeuvre
  - proximal symptoms - use distal movement
  - distal symptoms - use proximal movement
- Was the test positive? Remember this does NOT determine whether it is abnormal yet. It could be a normal positive test!
- Return to the rest position
- Do NOT ask about quality of the symptoms and other features during the manoeuvre. Wait until later.
- This helps to shorten the test
- When we do diagnosis later, we will analyse the symptoms in relation to the diagnostic categories
- You still make observations on range of motion, tissue resistance and adaptive movements etc.

**Normal Response**

**Symptoms** - pulling in the front of the elbow extending to the first three digits. Sometimes P+N in the hand in median nerve distribution. These change with neck side bending (Kenneally et al 1988).

**Range of movement** - anything between - 60°- full elbow extension (Pullos 1986, for review see Shacklock 2005).
Section 5

Neuropathodynamics
FUNCTIONAL DISORDERS

Audiovisual presentation

Diagnostic categories
Clinical features
**Aims**

Present some functional disturbances for diagnosis and treatment

Link neural system to the musculoskeletal system

Base the classifications on causal mechanisms

Mechanisms will interact and coexist

**Types of Dysfunction**

1. Mechanical interface
2. Neural
3. Innervated tissue

**Mechanical Interface**

Reduced Closing Dysfunction - Definition

When the mechanical interface lacks appropriate movement in the closing direction

Increased pressure on the nervous system

Space-occupying element eg. disc bulge, swollen joint, tendons etc.

Always suspect pathology

Reduced Closing Dysfunction (cont.)

Severe cases - contralateral shift

Less severe - reduced closing eg. extension or ipsilateral lateral flexion

Symptom production or reproduction on closing

Opening movements e.g. flexion or contralateral lateral flexion, rotation

Often co-exists with pathology eg. disc bulge, stenosis, swollen structure

Reduced Opening Dysfunction

Hypomobile/stiff in opening eg. contralateral lateral flexion and/or sometimes flexion

Severe cases - ipsilateral shift

Production or reproduction of symptoms with opening movement eg. contralateral lateral flexion

Neural tension signs common because opening movements pull on sensitive nerves
Neural Tension Dysfunction

Mechanisms

PATHOPHYSIOLOGY
Inflammation/hypoxia
Mechanosensitivity
Lower threshold
Increased response

MECHANICAL DYSFUNCTION
Tension movements
Viscoelastic changes

Neural Sliding Dysfunction

Mechanisms

PATHOPHYSIOLOGY
Inflammation/hypoxia
Mechanosensitivity
Lower threshold
Increased response

MECHANICAL DYSFUNCTION
Sliding movements
Contact with interface or impairment in sliding (adhesion)

Neural Sliding Dysfunction

Clinical Features

ABNORMAL TEST RESPONSE
Overt
Covert

TENSION MOVEMENTS
Increase symptoms

TENSION RELEASE
Decreases symptoms

Sliding Patterns

Distal
Proximal

Context for Sliding Dysfunctions

Sliding dysfunctions are rare but they do happen
Consistent responses to physical testing
Locating signs
History of pathological process in the region
Trauma, inflammation, degeneration
Radiological evidence of pathology in the interface
Not as likely in patients with erratic physical signs and central and psychosocial mechanisms.
**Mechanical Irritation**

- **Mechanical Irritation**
- **Nociceptor Activation**
- **Release of neuropeptides (SP, CGRP)**
- **Neuritis** + **Mechanosensitivity**

**Mechanosensitivity**

- **Overview**
  - Mechnosensitivity is how nerves hurt with movement.
- **Definition**
  - How easily impulses are activated from a site in the nervous system where mechanical force is applied.

**Mechanosensitive Axons**

- Sympathetic
- Motor
- Proprioceptive
- Nociceptive

**Pathophysiology Pressure - tourniquet effect**

- Direction of blood flow
- Object causing compression
- Swollen area of nerve due to back log of fluid

**Normal nerves hurt if you pull or push hard enough on them**
Full neurodynamic tests pull hard enough to produce a symptom response.

Mechanism?
- ischaemia
- stretch/nociceptive receptors

<table>
<thead>
<tr>
<th>STRUCTURAL DIFFERENTIATION</th>
<th>KIND OF RESPONSE</th>
<th>KIND OF NEURAL RESPONSE</th>
<th>RELEVANT?</th>
<th>CAUSE?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Musclekeletal no change in symptoms</td>
<td>Normal</td>
<td>Normal</td>
<td>No</td>
<td>Whole evaluation sinister - muscle - disc - joint - neuropathy - neuritis - interface - tension - sliding</td>
</tr>
<tr>
<td>Neurophysiological symptoms change</td>
<td>Normal</td>
<td>Normal</td>
<td>No</td>
<td>No reprod.</td>
</tr>
</tbody>
</table>

Normal 19 20
Section 6

*Physical Examination and Hypothesis Testing*

Practical/lab session

Observation
Hypothesis creation and testing
Physical examination targeted to neurodynamics
Observation

Purposes of Observation

Detect possible abnormalities in:

- body alignment
- pathology (biomedical) - tumours, medical conditions etc.
- pathological processes - inflammation, vascular changes
- routine part of the neuromusculoskeletal examination
- detect abnormal patterns with respect to NEURODYNAMICS
  - opening
  - closing
  - muscle dysfunction
  - neural tension

What to Look For

Body contours and postures that might suggest:

- closing and opening
- tension, compression

Frontal plane

- symmetry, midline
- rotated
- lateral flexion
- muscle activity
- contours
- hypertrophy
- wasting

The objective is to observe what changes that you can see are related to neurodynamics eg. closing or opening posture, tension/protective postures.

This part of the physical examination guides the therapist to what physical tests to do.

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Sagittal Plane

- flexion/extension
- lordosis
- hyperextension
- upper and lower cervical spine
- muscle contours - hyperactive, hypoactive

A common necessity in testing for a hidden neurodynamic component is to apply neurodynamic differentiation to see if it changes:

Yes - may be neurodynamic aspect

No - neurodynamics are not contributing therefore - eliminated.

This applies to almost any musculoskeletal dysfunction:

- opening, closing
- muscle and nerve
- specific movement and nerve - eg. postural change, shift, list, muscle tightness.
Planning the Physical Examination

Define your observations and develop hypotheses in relation to neurodynamics.

Upper cervical spine

Lower cervical spine
In order of priority, write down what physical tests you might do for the above patient and why.

Interface

Neural
Common Patterns in Muscle and Nerve

Upper Trapezius

With wrist extension

Levator Scapulae
Anterior and Middle Scalenes

Retraction

Ipsilateral rotation

Lateral translation

Lateral flexion

These are only the specific movement and it will be necessary to adjust hand positions at different stages of the technique.

Final position

Picture at left - hand positions for the technique.
Section 7

Treatment Method

Lecture

Working through a system of techniques
Treatment - working through a system of techniques

Note that the system of levels and types of examination applies to treatment in the same way that it does to examination.

SUMMARY OF TECHNIQUE SELECTION

<table>
<thead>
<tr>
<th>Pathophysiology</th>
<th>Pathomechanics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3a, b, c, d</td>
</tr>
</tbody>
</table>

General Principles

Observe symptoms at all times - before, during and after treatment.

Reassess symptoms and physical signs - particularly neurodynamic status immediately after treatment, unless there is reason not to, such as to avoid provocation or undue focus on the problem. This includes neurological examination when appropriate.

Classify the dysfunction

Base treatment on the dysfunction category and level/type of examination

Avoid the words ‘stretch’ and ‘tension’ - I say "this technique is designed to improve the function of the nerve"

Respect resistance - low, medium or high

Be extremely sensitive - because this forms the basis for close analysis between you and the patient so that treatment can be responsive and derived from the patient’s response.

Speed - slow and gentle

Amplitude - generally the movement should come back to the inner range each time so the mobilisations are usually medium to large in amplitude
Dosage/Repetitions - perform several movements then reassess symptoms at rest or some physical sign that is not irritated with reassessment. This may be performed up to several times in one treatment session, as long as there is some value in the technique.

Sometimes, at higher levels (2 and 3) treatment can evoke (or elicit) symptoms - but it should not provoke them. There is a difference. I use provoke to designate a more severe and long lasting response. Evoke suggests that symptoms have been triggered but more on an instantaneous basis rather than the response being long lasting.

**System of Technique Progression**
*General*

Slider Techniques

Are particularly good for pain

Produce a lot of neural movement without producing much tension

Can be used reduce possibility of treatment soreness and settle symptoms down with advanced treatments
Section 8

Treatment
Practical/lab session

Low back and radicular pain
Low Back and Radicular Pain

Treatment progressions

Mechanical interface - reduced closing dysfunction

The techniques below are particularly suited to patients with significant distal symptoms that involve pain, pins and needles or loss of sensation.

Indications

Predominantly distal symptoms - particularly pins and needles, numbness and weakness, neurological signs

Persistent/ continuous distal symptoms

Not as common to use these techniques with acute /severe low back pain without referral of symptoms into the lower limb

Distal symptoms provoked by closing movements - extension, ipsilateral lateral flexion

Reduced ROM of closing movements

Key aspect - MUST do a neurological examination before and after each treatment.

Treatment is directed at reducing the pathophysiology in the nerve root rather than the mechanical dysfunction. this is because to treat the mechanical dysfunction (ie. closing) would be to risk provoking the nerve root.

Reduced Closing Dysfunction

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Level 1 - Limited

1. Static Opener

Position - painful side uppermost with a bolster under the lower side.

Progression 1a. Towel between ilium and trochanter

Progression 1b - One leg over the side

Place in open position - painful side up, legs flexed to 90°, one foot placed over the side of the couch.

If this increases symptoms return foot to couch and place a bolster under waist instead.

Do not mobilise.

Degree of opening - depends on response to positioning

Duration - 30-60 seconds at first. If better, repeat several times. If the same, still repeat once more and reassess at the next session.

Monitor symptoms at rest and, if they improve, offer this position as a pain relief strategy.

Either leg can be lowered, depending which is more effective in achieving lateral flexion and what is more comfortable for the patient.

Progression 1c - Static Opener

Position - as above, two feet placed over the side of the couch. Dosage same as in progression 1.

Dosage - up to several minutes at a time, hourly. Good gains can be achieved by doing this manoeuvre several times per day.

Progression 1d - manual opening to maximize.
2. Dynamic Opener/mobilisation (Level 1 continued)

Passive opener - contralateral lateral flexion

Can be done as small or large amplitude, in the inner or outer range.

Can be performed as a home also

Level 2 - Standard

Indications/clinical features

At this point, there is little to be found on neurological examination.

The distal symptoms are not easily provoked and are now intermittent or absent.

Neurodynamic testing shows minor signs (overt abnormal response (OAR) and covert abnormal response (CAR) late in range).

The interface dysfunctions are still present (reduced closing).

Now the treatment changes from treating pathophysiology in the nerve root to treating the mechanical dysfunction in the interface.

Dynamic Closer

Closer mobilisation – inner, middle and outer range

Position - start mobilisation in open position and gently move toward closed position

Mobilisation - in the direction of closing but only to the neutral position.

Perform slowly and carefully and with respect to the patient’s symptoms and physical responses, especially resistance and protective responses.
Dosage - 5-6 gentle movements then reassess. if there is an improvement, repeat several more movements. If the same after mobilisations, repeat sets of mobilisations, stop and reassess at next session.

This can be progressed by positioning the patient into ipsilateral rotation, less hip/lumbopelvic flexion and even into some extension but care must be exercised.

Neural Dysfunctions

Clinical Features

Symptoms reproduced by movements that produce sliding in one particular direction.

Neural Tension dysfunction

- SLR painful +/- PNF painful in severe cases
- Slump - NF painful - KE painful

Level 1 Nerve Root Progressions

Tension Dysfunction

1. Position OUT - position OUT
   ipsilateral
   contralateral
2. Position OUT - move OUT
   ipsilateral
   contralateral
3. Position IN - move OUT
   ipsilateral
   contralateral
4. Position OUT - move IN
   contralateral
   ipsilateral
5. Position IN - move IN
   contralateral
   ipsilateral

Level 2 Standard Tests/techniques
Level/type 3a Tests/techniques
Moving Through the Progressions

It may not always be necessary to pass through each progression because they provide small increments. It is therefore possible in many patients to jump a progression or two. However, this should always be done carefully with respect to the patient’s signs and symptoms and sufficient time should be allowed between treatments so that accurate observation of patient responses can be achieved.

**Progression 1 Position OUT - Position OUT**

(ipsilateral) (contralateral)

**Position** – generic off-loaded position for the sciatic nerve,
- contralateral hip flexed approximately 90˚ if possible
- contralateral knee extension
- hold for approx. 15 secs, longer if comfortable and safe (no problems in the contralateral limb - pins and needles or other symptoms)

**Ipsilateral limb**

**Contralateral limb**

**Progression 2 - position OUT-move OUT (of tension)**

(ipsilateral) (contralateral)

As above (1) except the knee is extended and flexed
Perform approx. 5-10 times. This set can be repeated up to 3-5 more times

**Progression 3 - position IN-move OUT (of tension)**

(ipsilateral) (contralateral)

Ipsilateral lower limb in neutral

Ipsilateral dorsiflexion
Progression 4 - position OUT-move IN (to tension)
(contralateral) (ipsilateral)

Sitting
Position OUT
- contralateral knee extension
- protects nerve root
- dorsiflexion optional

Move IN
- ipsilateral knee extension
- dorsiflexion optional

OPTIONS:
- ipsilateral dorsiflexion
- neck flexion
Progression 5 - position IN-move IN (to tension)  
(contralateral) (ipsilateral)

From this

This was the progression 4 starting position.

Now the protection from the contralateral knee is removed (remove the contralateral knee extension).

To this:

Position IN  
Move IN - ipsilateral knee extension

Add cervical flexion  
Move IN - ipsilateral knee extension

WHAT IS THIS?

Option - add dorsiflexion

This is now level 2, the standard slump test.

You now have a wide variety of techniques below level two that are not likely to provoke symptoms.
Level/type 3a - Position IN - move IN (to tension)  

Contralateral lateral flexion  
Ipsilateral knee extension

HERE IS THE PROCEDURE FOR SAFER MORE ADVANCED TECHNIQUE

1. Test neurological function. If abnormal, this technique at level 3a is not recommended.

2. Position the patient comfortably.

3. Ask if the patient has any symptoms at rest. If “Yes”, do NOT proceed. The problem may not be at level 3.

4. Explain that symptoms may occur and, if they do, they must only be mild at most. Generally reproduction of the patient’s clinical symptoms is to be avoided. Stretching sensations are common.

5. Perform a test movement to the first onset of symptoms.
   
   5.1. make sure the patient moves slowly and carefully and that they learn to stop at the right place.
   
   5.2. return to the starting position and check that any symptoms disappear instantly. If not, wait until they do. If they take more than a few seconds, it may be better to do something more gentle.

6. If this goes according to plan:
   
   6.1. perform 3-5 movements the same way, making sure that the symptoms stop between movements.
   
   6.2. return to the start position for at least a second or two each time a movement is performed.

7. Do NOT stay in the end range position for more than about one second.

8. Test the neurological status to be sure that it has not deteriorated. If a deterioration occurs, the technique is contraindicated.
Position - as for slump test

Movement - cervical, thoracic, lumbar flexion, contralateral lateral flexion, knee extension, dorsiflexion.

Make sure the amplitude is large so you retreat from the symptomatic position each time.

Level/type 3c. Advanced - reduced closing with neural tension dysfunction

Reduced Closing and Neural Tension Dysfunctions

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Patient position - painful side up

Mobilisation - closing (ipsilateral lateral flexion) + neck flexion and knee extension (ie. two-ended tensioner)

This one often needs practice so the patients gets the movements right.
Starting position

Closer with knee extension/neck flexion
References


Breig A 1978 Adverse mechanical tension in the central nervous system. Almqvist and Wiksell, Stockholm

Butler D, Gifford L 1989 The concept of adverse mechanical tension in the nervous system. Physiotherapy 75 (11): 622-636


Coppieters M, Alshami A, Babri A, Souvlis T, Kippers V, Hodges P 2006 Strain and excursion of the sciatic, tibial, and plantar nerves during a modified straight leg raising test. Journal Orthopaedic Research 24 (9): 1883-1889


Coppieters M, Stappaerts K, Janssens K 2002 Reliability of detecting ‘onset of pain’ and ‘submaximal pain’ during neural provocation testing of the upper quadrant Physiotherapy Research International 7(3): 146–156


Daniels T, Lau J, Hearn T 1998 The effects of foot position and load on tibial nerve tension. Foot and Ankle International 19 (2): 73-78


Ellav E, Benoliel R, Tal M 2001 Inflammation with no axonal damage of the rat saphenous nerve trunk induces ectopic discharge and mechanosensitivity in myelinated axons. Neuroscience Letters 311: 49-52


Laban M, MacKenzie J, Zemenick G 1989 Anatomic observations in carpal tunnel syndrome as they relate to the tethered median nerve stress test. Archives of Physical Medicine and Rehabilitation 70: 44-46
Marshall J Nerve stretching for the relief or cure of pain. British Medical Journal 1883; 1173-1179
Miller A 1986 The straight leg raise. Unpublished Graduate Diploma in Advanced Manipulative Therapy thesis, University of South Australia


Nakamichi K, Tachibana S 1995 Restricted motion of the median nerve in carpal tunnel syndrome. Journal of Hand Surgery 20B: 460-464


Pechan J, Julis I 1975 The pressure measurement in the ulnar nerve. A contribution to the pathophysiology of cubital tunnel syndrome. Journal of Biomechanics 8: 75-79


Selvaratnam P, Cook S, Matyas T 1997 Transmission of mechanical stimulation to the median nerve at the wrist during the upper limb tension test. In: Proceedings of the Manipulative Physiotherapists’ Association of Australia, Melbourne: 182-188


Shacklock M 1995a Neurodynamics. Physiotherapy 81: 9-16


Shacklock M 1996 Positive upper limb tension test is a case of surgically proven neuropathy: analysis and validity. Manual Therapy 1: 154-161


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Shacklock M. Manual Therapy 2007 letter to the Editor, reply to Greening J, Leary R 2007
Shacklock M, Wilkinson M 2000 Dynamics of the median nerve in the wrist and forearm with specific active and passive movements of the upper limb and neck in the conscious human. Unpublished recordings, School of Medical Radiation, University of South Australia
Shacklock, M, Wilkinson M, Scutter S 2002 Dynamics of the median nerve at the elbow and posterior interosseous nerve during pronation and supination movements of the forearm. Unpublished recordings, School of Medical Radiation, University of South Australia
Tsai Y-Y 1995 Tension change in the ulnar nerve by different order of upper limb tension test. Master of Science Thesis, Northwestern University, Chicago
Werner C, Haeflener F, Rosén 1980 Direct recording of local pressure in the radial tunnel during passive stretch and active contraction of the supinator muscle. Archives of Orthopaedic and Traumatic Surgery 96: 299-301