

The Neurological Assessment in the context of Diabetes Peripheral Neuropathy



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Outcomes for this presentation

- ▶ What is neuropathy and why does it lead to such significant complications
- ▶ Understand what makes up a neurological assessment
- ▶ Review the different types of neurological tests
- ▶ Be aware of sensory, motor and autonomic neuropathy
- ▶ Understand what other tests can be used in assessment
- ▶ Understand when to refer on
- ▶ Understand what services and pathways are available

What is neuropathy

- ▶ Diabetic neuropathy is a descriptive term covering many clinical types or syndromes of neural damage. It is the most common chronic complication of diabetes and is responsible for a large amount of morbidity
- ▶ Peripheral **neuropathy**, a result of damage to the nerves outside of the brain and spinal cord (peripheral nerves) which leads to the presence of symptoms / signs of peripheral nerve dysfunction in people with diabetes after other pathologies have been excluded (IWGDF)
- ▶ Diabetic neuropathy is the most common complication associated with diabetes mellitus

▶ IWGDF

- ▶ LOPS (**loss of protective sensation**) : Assess with one of the following techniques
- ▶ Pressure Perception: Semmes Weinstein 10g monofilament
- ▶ Vibration Perception: 128 Hz tuning fork
- ▶ When monofilament or tuning fork are not available test tactile sensation: lightly touch the tips of the toes of the patient with the tip of your index finger for 1-2 secs

▶ NICE

- ▶ Neuropathy (use a 10 g monofilament as part of a foot sensory examination).
- ▶ Risk Stratify to determine likelihood of developing a diabetic foot problem

NICE Risk Stratification

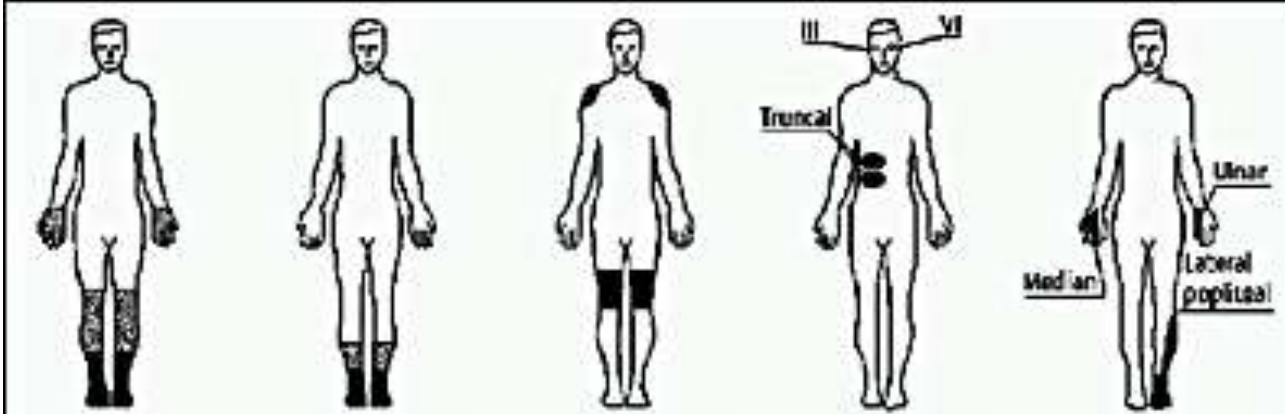
- ▶ **Low Risk:**
 - ▶ No risk factors present except callus alone
- ▶ **Moderate Risk:**
 - ▶ Deformity
 - ▶ Neuropathy
 - ▶ Non-critical limb ischaemia
- ▶ **High Risk:**
 - ▶ Previous ulceration or amputation
 - ▶ Renal RT
 - ▶ Neuropathy and non-critical limb ischaemia together or
 - ▶ Neuropathy in combination with callus and/or deformity or
 - ▶ Non-critical limb ischaemia in combination with callus and/or deformity.

▶ **Active diabetic foot problem:**

- ▶ Ulceration **or**
- ▶ Spreading infection **or**
- ▶ Critical limb ischaemia **or**
- ▶ Gangrene **or**
- ▶ Suspicion of an acute Charcot arthropathy, or an unexplained hot, red, swollen foot with or without pain

- ▶ Several types of neuropathy exist within patients with Diabetes:
- ▶ Polyneuropathy:
 - ▶ a) Sensorimotor
 - ▶ i) Acute
 - ▶ ii) Chronic
 - ▶ b) Autonomic
- ▶ Mononeuropathy
- ▶ Proximal motor neuropathy

Diagrammatic presentation of how neuropathy presents and which nerve fibres are affected



The diagram shows five human figures illustrating different neuropathy patterns. The first figure shows sensory loss in the feet (glove and stocking pattern). The second figure shows sensory loss in the hands. The third figure shows sensory loss in the hands and feet. The fourth figure shows sensory loss in the hands, feet, and trunk (labeled 'Truncal' with lines pointing to the back and arms). The fifth figure shows sensory loss in the hands and feet, with specific nerve palsies labeled: 'Median' (hand), 'Ulnar' (arm), and 'Lateral popliteal' (leg).

Large fiber Neuropathy	Small fiber Neuropathy	Proximal motor Neuropathy	Acute mono Neuropathies	Pressure Palsies
Sensory loss: 0-+++ (Touch, vibration) Pain: + -+++ Tendon reflex: N-↓↓↓ Motor deficit 0-+++	Sensory loss: 0-+ (thermal, allodynia) Pain: + -+++ Tendon reflex: N-↓ Motor deficit: 0	Sensory loss: 0-+ Pain: + -+++ Tendon reflex: ↓↓ Proximal Motor deficit: + -+++	Sensory loss: 0-+ Pain: + -+++ Tendon reflex: N Motor deficit: + -+++	Sensory loss in Nerve distribution: + -+++ Pain: + -+++ Tendon reflex: N Motor deficit: + -+++

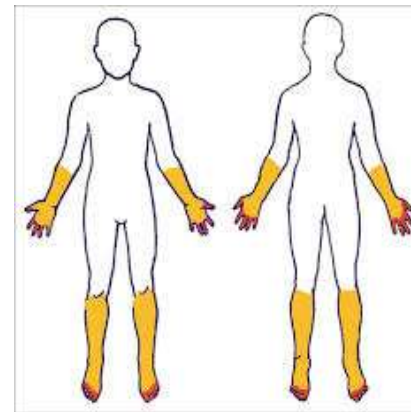
General overview of the types of neuropathy within Diabetes

- ▶ **Chronic sensorimotor neuropathy (distal symmetrical neuropathy)**
- ▶ Most common type - usually given the term 'diabetic neuropathy'
- ▶ First affects most distal parts of the longest nerves.
Affects up to 50% of those with diabetes after 25 years.
- ▶ There is a long asymptomatic latency period before clinically apparent.
- ▶ Most important permissive factor for diabetic foot complications (**LOPS - loss of protective sensation**)

Clinical features:

Predominantly sensory and symmetrical;

- ▶ first present in most distal aspects of the limbs; spreads in a 'stocking and glove' distribution;
- ▶ pain - may be sharp, stabbing or burning;
- ▶ skin tenderness (hyperaesthesia); paraesthesia and 'numbness'; useful early signs are decreased vibration sensation.
- ▶ Sensory changes may be initially asymmetric; progress is usually slow; irreversible

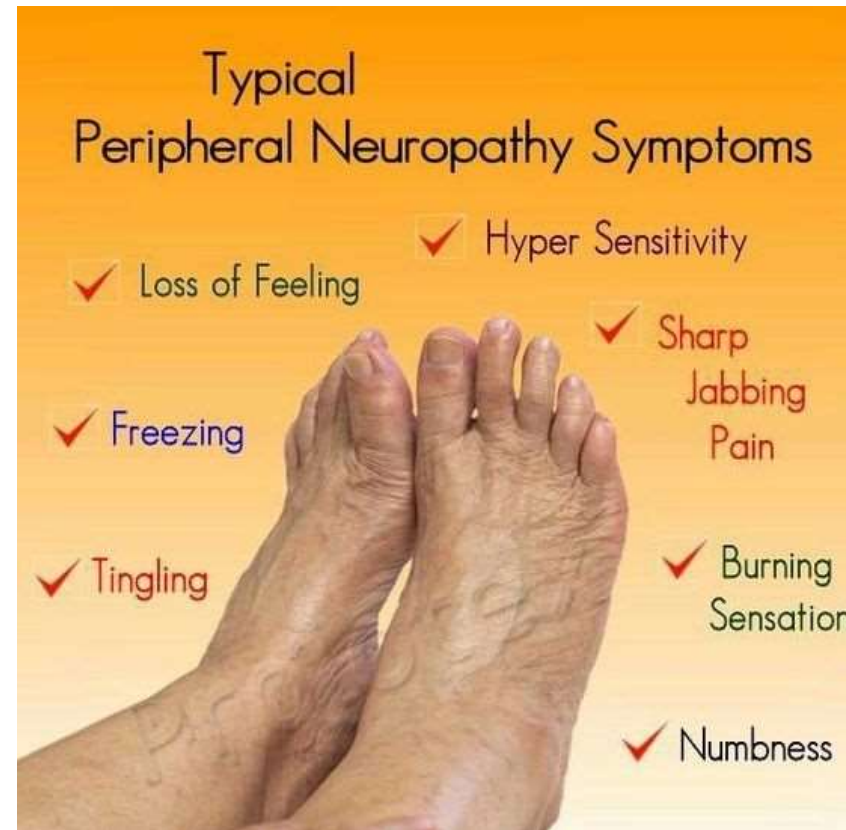


© Medgeeks
Peripheral
Neuropathy
Workup

- ▶ Foot is at risk of trauma
- ▶ Callus formation



©Zernich, Dowell, Tolchin **Understanding The Impact Of Diabetic Neuropathy On Gait**



©Labrum RC
10 Things You Need
to Know about
Peripheral
Neuropathy, the
New American
Epidemic
<http://www.healthandremedies.org>

- ▶ **Acute sensory neuropathy**
- ▶ Can occur with onset of insulin therapy; with ketoacidosis; following surgery; weight loss; normalisation of blood glucose levels following period of poor control
- ▶ Pain in extremities
- ▶ Recovery usually occurs - can take several months

- ▶ **Mononeuropathy or Focal Neuropathy:**
- ▶ Commonly cranial nerves (usually 3rd - orbital pain and/or headache), a carpal or tarsal tunnel neuropathy or a femoral neuropathy.
- ▶ Believed to be an acute ischaemic event to a nerve or nerve root; sudden onset; asymmetric; foot drop may be a complication ; self limiting course - cranial nerve involvement usually resolves within 3 months.

- ▶ **Proximal motor neuropathy/Diabetic amyotrophy:**
- ▶ Progressive asymmetrical atrophy and weakness of thigh muscles (unilateral or bilateral);
- ▶ deep pain in quadriceps muscles;
- ▶ hypersensitivity of skin over thighs;
- ▶ absent knee reflex, and instability in walking - falls; pain often affects sleep.
- ▶ Onset is usually acute; unilateral is more common; usually no sensory symptoms.
Most recover spontaneously.

- ▶ **Autonomic neuropathy**
- ▶ Common abnormalities in diabetes include:
Cardiovascular (eg postural hypotension); gastrointestinal (eg dysphagia, gastroparesis, constipation); genitourinary (eg impotence); sudomotor (eg gustatory sweating, nocturnal sweats); vasomotor (eg dependent oedema); eye (eg decreased pupil size, delayed response to light changes)
- ▶ In the foot the microcirculation control is affected by increased arteriovenous shunting; increased nutritive capillary flow at rest; reduced axon flare response; and impaired postural vasoconstriction.

DPN is a leading cause for disability due to foot ulceration and amputation, gait disturbance, and fall-related injury.

- ▶ Decreased awareness leading to inadvertent trauma and injury
- ▶ Elevated plantar pressures and occupy a longer duration of time in the stance-phase during gait
- ▶ Skin and soft tissue changes incl deformity
- ▶ Delay in seeking medical intervention for injury or infection due to absence of pain and discomfort

- ▶ Altered mechanics which leads to structural deformities



- ▶ Altered Foot Function
- ▶ Normal walking causing overloading of plantar areas
- ▶ Skin is less flexible and reacts differently under pressure/sheer
- ▶ Callus build up causes increased pressure resulting in underlying ulceration



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2015



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In the foot a variety of affectations....



<https://topshoeswomen.com/shoes-for-neuropathy/>



https://www.rdehospital.nhs.uk/patients/services/diabetes/footcare/neuropathy_signs.html



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<http://www.diabetes.bm/podiatry2.htm>



<https://www.orthobullets.com/foot-and-ankle/7047/diabetic-charcot-neuropathy>

▶ Neuropathic Pain

- ▶ Pain is extremely intense and among the most disabling symptoms for the patients
- ▶ Pain and related neuropathic symptoms and signs may vary.
- ▶ Neuropathic pain can be spontaneous
- ▶ Spontaneous symptoms are described as uncommon tactile and thermal sensations associated with numbness, tingling, pins and needles, burning, shooting, and electric shock-like sensation. Neuropathic pain may also be evoked.
- ▶ Pain may also be evoked by natural stimulation of an abnormally sensitive area with exaggeratedly intense or distorted abnormal sensations such as allodynia or hyperalgesia.

<https://blogs.ohsu.edu/brain/2015/09/24/a-cupuncture-and-diet-changes-to-treat-neuropathic-pain/>



Management

- ▶ Therapies . N. Çakici et al; Diabetic Medicine; 2016; Systematic review
- ▶ 2687 Dedicated records
- ▶ 1658 Excluded
- ▶ 1020 articles forwarded for full text review, these where RCT's investigating pharmacological and non pharmacological, and alternative treatment for people with diabetes and PDN...
- ▶ Further 993 articles excluded (no placebo, no control group non randomised...)
- ▶ 27 articles included in the review:
- ▶ Findings: Significant improvement with:
 - ▶ Opioids
 - ▶ Botulinum
 - ▶ Mexidol
 - ▶ Reflexology
 - ▶ Thai foot massage

The Neurological Assessment

- ▶ Comprehensive Medical history and History of complaint in addition to assessment of other systems, including comprehensive VASCULAR assessment
- ▶ Semmes - Wienstein monofilament → 10 gram
- ▶ Tuning fork (128 Hz)



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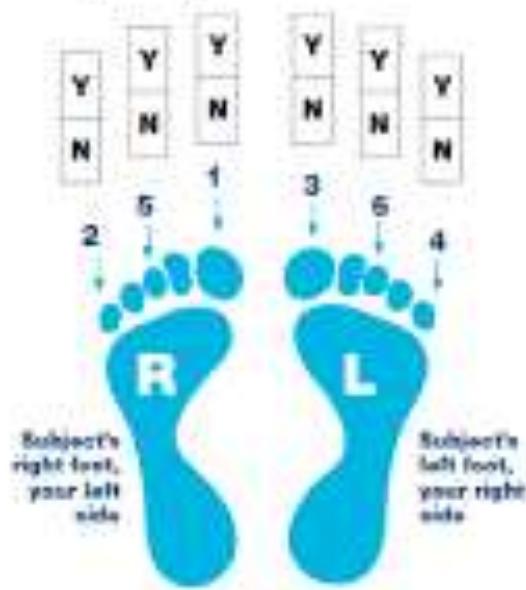


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An alternative method to test LOPS

Touch the toes test.

Does your patient with diabetes have reduced sensation?



- Ask the patient to close their eyes
- Tell the patient you are going to touch their toes
- Ask them to tell you which foot you touched, left or right
- Touch toe number 1 for two seconds gently. Do not repeat.
- Continue until you have assessed 6 toes as marked on the diagram.
- If patient cannot feel two or more toes they have reduced sensation and are at risk of a diabetic foot ulcer. Their feet should be checked for ulceration and protected from pressure damage with a heel protector eg Previlon Boot.

The Ipswich Touch Test <https://www.slideshare.net/stierney/diabetic-foot-2015-44495301> Vascular surgery @ Tallaght Ipswich Touch test • If ≥ 2 (of 6) missed • Sensitivity 77% • Equivalent to SWMF Rayman G. Diabetes Care. Jul 2011; 34(7): 1517-1518.

Light Touch



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Proprioception



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Temperature



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Two point discrimination



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Reflex Testing

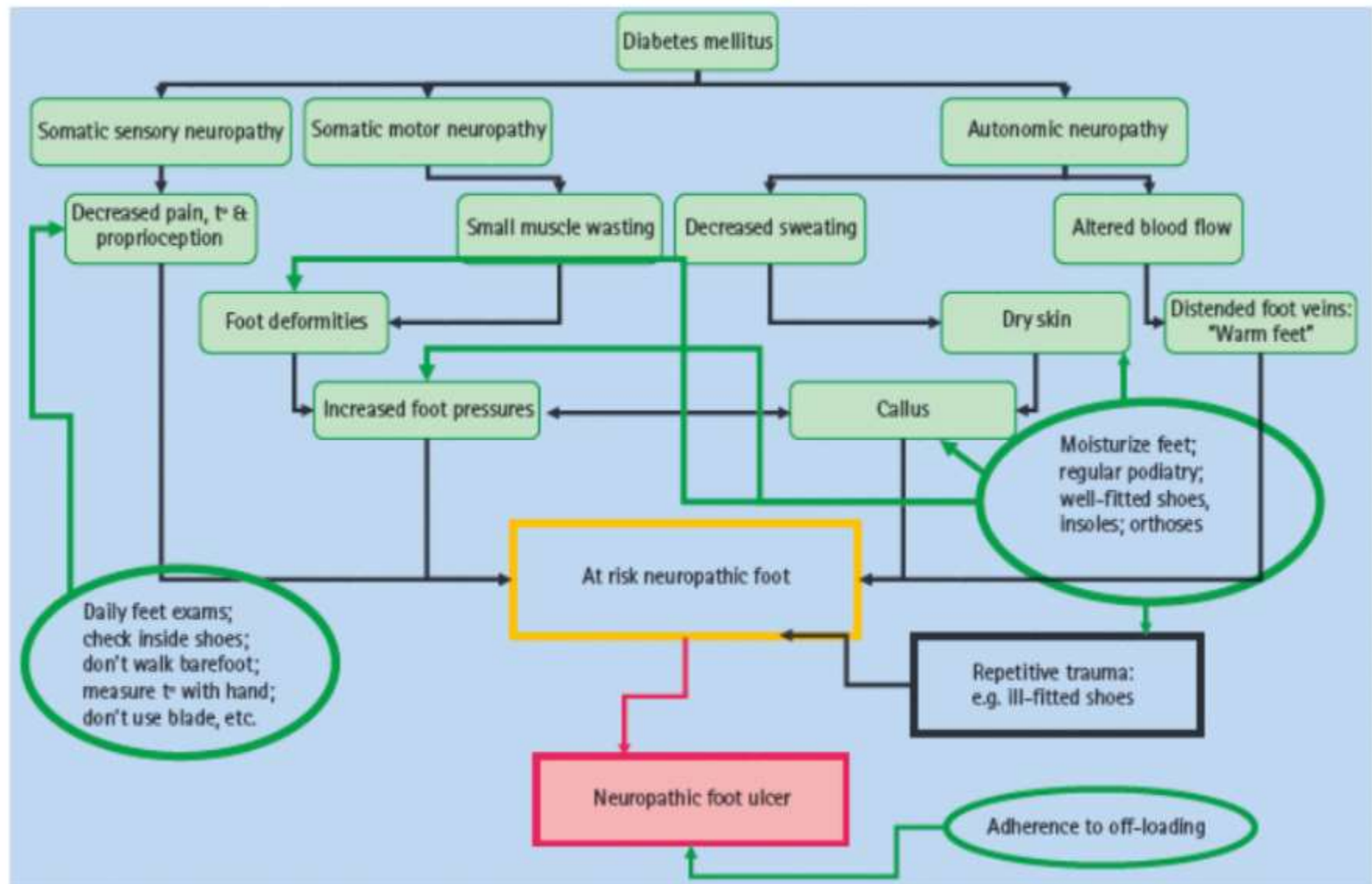


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Motor Testing



<https://meded.ucsd.edu/clinicalmed/neuro2.htm>



Risk classification based on the comprehensive foot examination^{1,2}

Risk Category	Definition	Treatment Recommendations	Suggested Follow-up
0	No LOPS, no PAD, no deformity	<ul style="list-style-type: none"> • Patient education including advice on appropriate footwear 	Annually (by generalist and/or specialist)
1	LOPS ± deformity	<ul style="list-style-type: none"> • Consider prescriptive or accommodative footwear • Consider prophylactic surgery if deformity is not able to be safely accommodated in shoes. Continue patient education 	Every 3 to 6 months (by generalist and/or specialist)
2	PAD ± LOPS	<ul style="list-style-type: none"> • Consider prescriptive or accommodative footwear • Consider vascular consultation for combined follow-up 	Every 2 to 3 months (by specialist)
3	History of ulcer or amputation	<ul style="list-style-type: none"> • Same treatment recommendations as for Risk Category 1 • Consider vascular consultation for combined follow-up if PAD present 	Every 1 to 2 months (by specialist)

Adapted from Boulton et al. *Diabetes Care*. 2008;31(8):1679-1685.
This is one clinical perspective for evaluating risk based on a comprehensive foot examination in the medical literature.

- ▶ Be aware of your local Foot Protection Services and local Pathways

Thank You



References and Resources

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Published date: August 2015 Last updated: October 2019
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<https://www.sign.ac.uk/sign-116-and-154-diabetes.html>
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Annexure: Basic guide on assessment techniques

- ▶ Please note that there are various ways in which to complete the assessments; these are OSCE sheets developed by F Cassim and C. Vincent-Lambert based on our understanding of the tests. We are aware that methods change over time so there may be updated versions of these assessments
- ▶ We are happy to share these however should you wish to share further please acknowledge our contribution.

Light Touch

NEURO-SENSORY ASSESSMENT	
Assessment	Expected Actions
Light Touch	Explain the procedure to the patient. Demonstrate procedure on patient's hand.
	Patient is positioned seated with legs extended and asked to close eyes whilst test is being completed.
	The skin of the foot is stroked lightly with cotton wool. Start distal to proximal both on the dorsum and plantar aspects of the foot. Move up the leg.
	The patient must indicate when the foot is being stroked and the site being stroked.
	Conduct test on both feet.
	Document findings.

Pressure Sensation

NEURO-SENSORY ASSESSMENT	
Assessment	Expected Actions
Pressure Sensation	Examine the monofilament for defects. <i>The monofilament should be straight and erect with no kinks or defects.</i>
	Explain the procedure to the patient. Demonstrate procedure on patient's upper arm or hand.
	The patient must state where and when the pressure from monofilament is felt at various points (yes/no) Where (left / right).
	The following sites are usually tested on both feet: apex of hallux and 3rd toe, 1st, 3rd, 5th met head and plantar calcaneal area. It is also prudent to test the dorsum of the foot and the dorsal web space of the 3rd toe.
	Patient is positioned seated with legs extended and asked to close eyes whilst test is being completed.
	The monofilament is held at a right angle on the skin surface at the site being tested. The monofilament is deformed into a "C" shape. Hold for 2 secs. Patient must indicate if they felt the monofilament or not and at which site.
	Document findings indicating exactly at which sites patient did not perceive monofilament. Patient considered to have lost protective sensation if non-detection of the 10g monofilament on more than 1 site per foot is found.

Temperature

NEURO-SENSORY ASSESSMENT	
Assessment	Expected Actions
Temperature	Explain the procedure to the patient. Demonstrate procedure on patient's hand.
	Patient is positioned seated with legs extended and asked to close eyes whilst test is being completed.
	Place the two flat ends of the Tip Therm on the dorsum and plantar aspect of the foot at irregular intervals.
	Patient to report if there are any differences felt between the temperature of the two ends. Conduct test on both feet.
	Document findings.

Vibration

NEURO-SENSORY ASSESSMENT	
Assessment	Expected Actions
Vibration	Use a 128 Hz tuning fork or the graduated Reidel-Seiffer version for this test.
	Pinch ends of tuning fork to elicit vibration. <i>Do not bang tuning fork to elicit vibration.</i>
	Demonstrate on patients hand the difference between vibration and pressure.
	Patient is seated with legs extended and asked to close eyes whilst test is being completed.
	Pinch the ends of the tuning fork to elicit vibration and place perpendicular on the skin surface with a constant pressure, above a bony prominence. Sites which can be tested are the apex of the hallux, malleolus, and 1st Metatarsophalangeal Joint (MTPJ).
	It is important to conduct a sham test: patient must differentiate between pressure and vibration.
	Conduct test on both feet.
	Document findings.

Pain

NEURO-SENSORY ASSESSMENT	
Assessment	Expected Actions
Pain	<p>It is best to use disposable Neurotips® for this test. <i>Under no circumstances must the sharp end of the patella hammer or a hypodermic syringe be used for this test.</i></p>
	Explain the procedure to the patient. Demonstrate procedure on patient's hand differentiating between the blunt and sharp ends.
	Patient is positioned seated with legs extended and asked to close eyes whilst test is being completed.
	The blunt and sharp ends are applied randomly to the proximal end of the toenail of the hallux or the plantar aspect of the foot with just enough pressure to deform the skin slightly.
	Patient must differentiate between which end is sharper.
	Conduct test on both feet.
	Inability to perceive either end is considered abnormal.
	Document findings.

Neuromotor assessment

ASSESSMENT	EXPECTED ACTIONS
Ankle Reflex	Explain the procedure to the patient.
	Patient is kneeling over the edge of the examination couch or lying supine with the foot resting over the edge of the couch.
	The ankle is held in a dorsiflexed position in order to stretch the Achilles tendon until the ankle is locked and there is no movement.
	Using a patellar hammer strike the Achilles tendon. Note that this should not be done with a considerable amount of force.
	If the reflex is absent repeat the test by asking the patient to hook their fingers together in a clasp and pull. Strike the Achilles tendon using the patellar hammer.
	Total absence of the ankle reflex either at rest or with hooking the fingers together denotes an abnormality.
	Conduct test on both feet.
	Document findings.

NOTE: The ankle jerk reflex is mediated by the S1 nerve root.

ASSESSMENT	EXPECTED ACTIONS
Patellar/Knee Jerk Reflex	Explain the procedure to the patient.
	Patient is sitting with legs hanging freely over the edge of the couch.
	Use one hand to firmly hold the thigh just above the knee cap.
	Using a reflex/patellar hammer strike directly onto the quadriceps tendon (don't do it too hard so as to inflict pain on the patient)
	A normal or brisk knee jerk would have little more than one swing forward and one back.
	Conduct test on both legs.
	Document findings.

NOTE: The knee jerk reflex is mediated by the L3 and L4 nerve roots, mainly L4. Insult to the cerebellum may lead to pendular reflexes. Pendular reflexes are not brisk but involve less damping of the limb movement than is usually observed when a deep tendon reflex is elicited. Patients with cerebellar injury may have a knee jerk that swings forwards and backwards several times. Pendular reflexes are best observed when the patient's lower legs are allowed to hang and swing freely off the end of an examining table.

ASSESSMENT	EXPECTED ACTIONS
Muscle Power	Explain procedure to patient.
	Patient may lie prone or sit with legs extended.
	Ask patient to actively dorsiflex and plantarflex the foot against practitioner's hands i.e. against resistance.
	Do both feet simultaneously in order to determine if there is a reduction in strength or differences between the left and right side of the body.
	Document findings.
Muscle Tone	Observe the patients muscle tone.
	In a normal healthy person, the muscle will feel firm.
	In patients with Motor Neurone damage the muscle will either be in spasm (increase tone) or be flabby (decrease tone).
	Document findings.

Proprioception

ASSESSMENT OF PROPRIOCEPTION	
Assessment	Expected Actions
Proprioception in Joints	Explain the procedure to the patient.
	Patient is positioned seated with legs extended and asked to close eyes whilst test is being completed.
	Hold the sides of the hallux with the forefinger and thumb.
	Move the toe up and down and ask the patient to report the final position of the toe.
	Conduct test on both feet.
	Document findings.