

## SEARCH 4 MOP

### Section 14 - Michigan Neuropathy Screening Instrument (MNSI)

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## 14. Michigan Neuropathy Screening Instrument (MNSI)

### 14.1. BACKGROUND

The Michigan Neuropathy Screening Instrument (MNSI) is designed to screen for the presence of diabetic neuropathy. The MNSI is designed to be used in an outpatient setting by primary care or other providers. The first part of the screening instrument consists of 15 self-administered “yes or no” questions on foot sensation including pain, numbness and temperature sensitivity (see Appendix A for the patient screening instrument). A higher score (out of a maximum of 13 points) indicates more neuropathic symptoms. The questions were chosen from among those in the Neuropathy Screening Profile of Peter Dyck that showed the highest degree of specificity and sensitivity for diabetic neuropathy among normal subjects and those with a variety of neuromuscular disorders (Neurology, 36:1300- 1308, 1986).

The second part of the MNSI is a brief physical examination involving 1) inspection of the feet for deformities, dry skin, hair or nail abnormalities, callous or infection, 2) semi- quantitative assessment of vibration sensation at the dorsum of the great toe, 3) grading of ankle reflexes and 4) monofilament testing (see Appendix A for the Physical Assessment to be filled out by the health professional). Patients screening positive on the clinical portion of the MNSI (greater than 2 points on a 10 point scale) are considered neuropathic and referred for further evaluation.

### 14.2. SCORING OF THE MNSI

For the patient questionnaire, a higher score (out of a maximum of 13 points) indicates more neuropathic symptoms. Responses of “yes” to items 1-3, 5-6, 8-9, 11-12, 14-15 are each counted as one point. A “no” response on items 7 and 13 counts as 1 point. Item #4 is a measure of impaired circulation and item #10 is a measure of general anesthesia and they are not included in scoring. To decrease the potential for bias, all scoring information has been eliminated from the patient version of the questionnaire.

The examination is scored based on the total of abnormal findings for both feet. The appearance of the foot is graded as “Normal - Yes or No”. A “Yes” response is scored “0”; a “No” response is scored “1”. The number of abnormalities does not matter for scoring, but examiners should document all relevant abnormalities observed. Ulcer is graded as “present” (1 point) or “absent” (0 points). An ulcer is defined, in part, by depth (extending below the skin and into or through subcutaneous tissue, inflammation, and slow healing). Examiners are cautioned not to report simple wounds, broken skin, blisters, cuts, lacerations, etc. as ulcers. Ankle reflexes are graded as “present” (the expected reflex response is obtained by striking the Achilles tendon with a reflex hammer - 0 points), “present/reinforcement” (the response is obtained by striking the Achilles tendon with a reflex hammer while the patient does the Jendrassic maneuver - 0.5 points), or “absent” (the response cannot be obtained - 1 point). Vibration is graded as “present” (the **examiner** feels vibration on his/her finger joint for **less than 10 seconds** after the **patient** reports vibration perception has stopped on the **patient’s**

great toe - 0 points), “reduced” (the **examiner** feels vibration on his/her finger joint for **10 seconds or longer after the patient** reports vibration perception has stopped on the **patients** great toe - 0.5 points), or “absent” (the **patient** is unable to feel the vibration of the tuning fork when applied to the DIP joint of the great toe - 1 point). For the monofilament test, eight or more correct responses out of 10 applications to the great toe is considered “normal” or “present”: one to seven correct responses is “reduced” and no correct answers is “absent” monofilament perception.

A high score on the questionnaire (7 or more), or a score of greater than 2 (for appearance, ulcer, reflex and vibration portions of the exam) are indicative of peripheral neuropathy. Reduced or absent monofilament perception also suggests neuropathy. It is important to remember though, that the MNSI is a screening instrument, and not a diagnostic tool. Abnormal findings may warrant further evaluation and may indicate a need for patient education regarding appropriate care of the feet.

### 14.3. SUPPLIES

- 1) Patient questionnaire and examiner guide sheet (see Appendix A)
- 2) 128 Hz tuning fork
- 3) Reflex hammer (Trömner or Queen Square are preferred hammers)
- 4) 10 gram monofilament

### 14.4. PROCEDURE

#### 14.4.1 *History Questionnaire*

- a. Explain the MNSI to the patient. The following script is suggested:

*“The doctor has administered this test as part of your health evaluation. It measures the health of the sensory nerves in your skin. These are the nerves that detect sensations such as touch, pressure and temperature. The first part of this evaluation is a questionnaire that asks about the sensation in your feet. Answer the questions honestly and to the best of your ability.”*

- b. Administer the attached questionnaire to the patient. Allow him/her as much time as needed to complete it. When the patient completes the exam, move on to the second part of the exam.

#### 14.4.2 *Physical Exam: Inspection*

Explain the procedure to the patient. The following script is suggested:

*“Thank you for completing the questionnaire. Now we’ll move on to the physical exam. I’ll use a tuning fork to test the vibration sense in your foot, and then a reflex hammer to test the*

*reflexes in your ankle. Neither procedure is painful. Let me know if you have any questions about what I'm doing."*

Inspect the patient's feet for abnormalities and ulcers. Abnormalities that should be reported include **excessively** dry/cracked skin, large callous formation (thick, yellowish, waxy skin, generally occurring in an area of pressure, e.g., the ball of the foot, or side or plantar surface of great toe, heel. Note that corns are a form of callus.), fissures, deformities, and infections. Deformities include flat feet (absence of normal arch), hammer toes (toes are 'drawn back' leading to elevation of the interphalangeal joints), claw foot deformity (similar to hammer toes, but with a 'hooked' appearance of the distal toe joints) overlapping toes, bunions (over-growth of bone in response to chronic pressure generally leading to joint deformity/abnormal lateral prominence of the metatarsal head of the great toe (Halux Valgus) or fifth toe ("Tailor's bunion" or "bunionette" – bunionettes may also be seen on the tops of interphalangeal joints), joint subluxation (dislocated joints), prominent plantar metatarsal heads (usually seen with an abnormally high foot arch), medial convexity (Charcot foot – "rocker bottom foot") and amputation of all or part of the foot. Reportable infections include athlete's foot infection, and toenail fungus ("onychomycosis") or infections of the toenail. Pictures of many of the abnormalities listed above are shown in Appendix B. See Appendix C for guidance on how to report wounds and other abnormalities on the MNSI.

When examining the feet for ulcer, the following definition should be used. Ulcers are defined as follows: *a traumatic or non-traumatic excavation (loss) of subcutaneous tissue in the foot, with evidence of inflammation and/or infection that requires medical or surgical treatment by a health professional in an office or hospital setting. The "foot" is defined by all anatomic structure distal to the malleoli (e.g., everything below the ankle bone).* Note that cuts, lacerations, blisters, scrapes, etc., are not ulcers and should not be reported as abnormalities on the MNSI.

The purpose of the MNSI foot inspection is to identify abnormalities that are frequently associated with peripheral neuropathy. DO NOT report the following abnormalities on the MNSI: cuts, scrapes, scars, bruises, dirt, webbed feet, fused toes (syndactyly – which is a congenital defect), extra toes (polydactyly – also a congenital defect), poor circulation, spider veins, varicose veins, skin discoloration, depigmentation, etc. While these may have clinical relevance (e.g., representing poor circulation, or altering weight bearing and gait) they should not be reported on the MNSI.

See pictures in Appendix B for examples of foot abnormalities that should be reported on the MNSI. Section 17.3.1.2 reviews what a staff member should do if a participant has an untreated ulcer or infection found during inspection of their feet. The research team member will recommend that the participant contact their provider/primary care physician for

evaluation and treatment. If there is a need to send the participant for urgent care, the research staff will document in the research chart the findings and recommendation.



Figure 1. Distal Interphalangeal Joint (DIP) of Great Toe (arrow)

#### 14.4.3 *Vibration Perception*

Vibration perception is tested on both feet, using a 128 Hz tuning fork. To help the patient understand the test, place the non-vibrating fork on the great toe, directly on the bony prominence of the patient's distal interphalangeal (DIP) joint. (Figure 1)

Tell the patient that they should feel "pressure" from the tuning fork. Next, strike the tuning fork against your hand or other solid object and place the now vibrating fork on the DIP joint. Ask the patient if he/she can detect the difference between the non-vibrating fork ("just pressure") and vibrating ("buzzing or vibrating") fork. This will help the patient to understand the sensation you will ask them to respond to. You can also do this example using a joint in the patient's hand rather than the foot.

The vibration test is performed with the foot unsupported, with the exception of light support at the great toe (distal to the placement of the tuning fork- Figure 2). The test is done with the patient's eyes closed. Have the patient close his/her eyes, then place the vibrating tuning fork on the DIP joint as previously described. Ask the patient to "say stop" when (s)he can no longer feel the vibration of the fork (although the pressure of the fork may still be felt.). When the patient indicates that (s)he no longer feels vibration, quickly move the tuning fork to a distal joint on **your** thumb or index finger and using a watch or other timing device, wait for 10 seconds to pass.



Figure 2. Placement of the tuning fork on the DIP joint with distal support of the great toe.

Vibration scoring is based on the amount of time that the examiner feels the vibration after the patient reports that the vibration has stopped. Vibration is graded as “present” (the **examiner** feels vibration on his/her finger joint for **less than 10 seconds** after the **patient** reports vibration at the great toe has stopped), “reduced” (the **examiner** feels vibration on his/her finger joint for **10 seconds or longer after the patient** reports vibration perception at the great toe has stopped on the **patients** great toe), or “absent” (the **patient** is unable to feel the vibration of the tuning fork when applied to the DIP joint of the great toe).

Repeat the procedure on the other great toe, and record the findings on the MNSI form.

#### 14.4.4 Reflex Test

Test the ankle reflex using an appropriate reflex hammer (e.g., Trömner or Queen Square). The patient should be in a relaxed, seated position with the feet dependent (e.g., dangling freely, or, resting lightly on the examiners thigh-Figure 3).

Gently lift the foot (or place the foot on your thigh) in order to stretch the Achilles tendon. Encourage the patient to relax.

Strike the Achilles tendon firmly with the reflex hammer and feel whether there is downward flexion of the foot (as if someone was pressing down quickly on a gas pedal). If there is no response, try repositioning the patient, making sure that the foot is relaxed and



that there is sufficient stretch along the tendon (created by the examiner lifting the foot), and that the hammer is striking the tendon with sufficient force.



Figure 3: Positioning for ankle reflex testing

If no response is obtained, ask the patient to perform the Jendrassic maneuver. This is done by the patient hooking his or her hands together and pulling outward. You can also ask the patient to grit his teeth while pulling. This technique directs the patient's attention to the task of pulling against his/her own resistance, effectively distracting them from tensing his or her lower extremities. Strike the tendon while the patient is doing the Jendrassic maneuver to see if the reflex can be obtained. More than one attempt can be made.

Ankle reflexes are graded as “present” (the expected reflex response is obtained by striking the Achilles tendon with a reflex hammer), “reduced” or “present with reinforcement” (the response is obtained by striking the Achilles tendon with a reflex hammer while the patient does the Jendrassic maneuver), or “absent” (the response cannot be obtained despite optimal positioning and using the Jendrassic maneuver).

Reflex testing is performed on both feet. Responses are recorded on the MNSI form.

#### 14.4.5 Monofilament Test

For this examination, it is important to support the patient's foot (i.e., allow the sole of the foot to rest on a flat, warm surface, e.g., the floor or the examiner's hand).

Pre-stress the filament by applying it to your hand 5 or 6 times. The filament must be applied with enough pressure so that it achieves a “C”-shaped bend. This step can also be done using the patient's hand and will help them to understand the sensation that you will ask him or her to respond to, and will reassure the patient that the filament is not sharp, and will not hurt.

Ask the patient to close his/her eyes during the test. Apply the filament perpendicularly and briefly (<1 second) with an even pressure to the big toe, midway between the nail fold and the DIP joint. Do not hold the toe directly, but support the sole of the foot (either with your hand, or the foot may be on the floor). Make sure to apply enough force to obtain a “C”-shaped bend in the filament. When the filament bends to this shape, a force of 10 grams has been applied. (Figure 4)

Ask the patient to respond “yes” whenever (s)he feels the filament on the big toe. It is helpful to stagger the intervals between each touch of the filament. Make sure to allow enough time between applications to allow the patient to respond.



Figure 4. Application of Monofilament to Big Toe

The monofilament test is done on both feet. Record the findings on the MNSI form. For the monofilament test, eight correct responses out of 10 applications to the great toe is considered “normal” or “present”: one to seven correct responses is “reduced” and no correct answers is “absent” monofilament perception.

#### 14.4.6 Conclusion

Thank the patient for his/her participation. The following script is suggested:

*“Thank you for participating in this testing. The findings may or may not involve or benefit you directly, but are intended to improve the diagnosis and wellbeing of adolescents with diabetes.”*



**Addendum:**

The MNSI is a validated assessment. The MNSI should be administered/performed whenever possible in the same manner and sequence in which the validation occurred. Therefore, it is preferable for the exam to be performed with the patient comfortably seated, with legs non-supported and hanging freely. The order of assessment is inspection, reflexes, vibration and monofilament. As reflexes are done with legs dependent, it is very simple to follow the assessment of reflexes with the vibration and monofilament tests, while the legs are still dependent. If there are circumstances that prohibit the patient from sitting for the examination, then the patient may lay on an examination table, with the legs supported for the inspection, vibration and monofilament tests. Care needs to be taken to make sure, especially during vibration testing, that the patient is attentive to and responding to vibration at the DIP joint of the great toe, and not to vibration felt at other points of the foot or leg.

## Appendix A: MICHIGAN NEUROPATHY SCREENING INSTRUMENT

### Patient version

#### A. History (To be completed by the person with diabetes)

Please take a few minutes to answer the following questions about the feeling in your legs and feet. Check yes or no based on how you usually feel. Thank you.

- |   |                             |                              |
|---|-----------------------------|------------------------------|
| 1. Are your legs and/or feet numb?  | <input type="checkbox"/> No | <input type="checkbox"/> Yes |
| 2. Do you ever have any burning pain in your legs and/or feet?                                  | <input type="checkbox"/> No | <input type="checkbox"/> Yes |
| 3. Are your feet too sensitive to touch?  | <input type="checkbox"/> No | <input type="checkbox"/> Yes |
| 4. Do you get muscle cramps in your legs and/or feet?   | <input type="checkbox"/> No | <input type="checkbox"/> Yes |
| 5. Do you ever have any prickling feelings in your legs or feet?                                | <input type="checkbox"/> No | <input type="checkbox"/> Yes |
| 6. Does it hurt when the bed covers touch your skin?  | <input type="checkbox"/> No | <input type="checkbox"/> Yes |
| 7. When you get into the tub or shower, are you able to tell the hot water from the cold water? | <input type="checkbox"/> No | <input type="checkbox"/> Yes |
| 8. Have you ever had an open sore on your foot?   | <input type="checkbox"/> No | <input type="checkbox"/> Yes |
| 9. Has your doctor ever told you that you have diabetic neuropathy?                             | <input type="checkbox"/> No | <input type="checkbox"/> Yes |
| 10. Do you feel weak all over most of the time?   | <input type="checkbox"/> No | <input type="checkbox"/> Yes |
| 11. Are your symptoms worse at night?   | <input type="checkbox"/> No | <input type="checkbox"/> Yes |
| 12. Do your legs hurt when you walk?  | <input type="checkbox"/> No | <input type="checkbox"/> Yes |
| 13. Are you able to sense your feet when you walk?  | <input type="checkbox"/> No | <input type="checkbox"/> Yes |
| 14. Is the skin on your feet so dry that it cracks open?  | <input type="checkbox"/> No | <input type="checkbox"/> Yes |
| 15. Have you ever had an amputation?  | <input type="checkbox"/> No | <input type="checkbox"/> Yes |

Total: \_\_\_\_\_

## MICHIGAN NEUROPATHY SCREENING INSTRUMENT

**To be completed by health professional**

### B. Physical Assessment

1. Appearance of Feet

<b>Right Foot</b>			<b>Left Foot</b>		
a. Normal	1 <input type="checkbox"/> No	2 <input type="checkbox"/> Yes	Normal	1 <input type="checkbox"/> No	2 <input type="checkbox"/> Yes
b. If no, check all that apply:			If no, check all that apply:		
Deformities	1 <input type="checkbox"/>		Deformities	1 <input type="checkbox"/>	
Dry skin, callus	1 <input type="checkbox"/>		Dry skin, callus	1 <input type="checkbox"/>	
Infection	1 <input type="checkbox"/>		Infection	1 <input type="checkbox"/>	
Fissure	1 <input type="checkbox"/>		Fissure	1 <input type="checkbox"/>	
Other	1 <input type="checkbox"/>		Other	1 <input type="checkbox"/>	
Specify: _____			Specify: _____		

<b>Right Foot</b>			<b>Left Foot</b>			
2. Ulceration	Absent 1 <input type="checkbox"/>	Present 2 <input type="checkbox"/>	Absent 1 <input type="checkbox"/>	Present 2 <input type="checkbox"/>		
3. Ankle Reflexes	Present 1 <input type="checkbox"/>	Present/ Reinforcement 2 <input type="checkbox"/>	Absent 3 <input type="checkbox"/>	Present 1 <input type="checkbox"/>	Present/ Reinforcement 2 <input type="checkbox"/>	Absent 3 <input type="checkbox"/>
4. Vibration perception at great toe*	Present 1 <input type="checkbox"/>	Reduced 2 <input type="checkbox"/>	Absent 3 <input type="checkbox"/>	Present 1 <input type="checkbox"/>	Reduced 2 <input type="checkbox"/>	Absent 3 <input type="checkbox"/>
5. 10 gm filament (number of applications detected out of 10 applications):	Present (≥ 8) 1 <input type="checkbox"/>	Reduced (1-7) 2 <input type="checkbox"/>	Absent (0) 3 <input type="checkbox"/>	Present (≥ 8) 1 <input type="checkbox"/>	Reduced (1-7) 2 <input type="checkbox"/>	Absent (0) 3 <input type="checkbox"/>

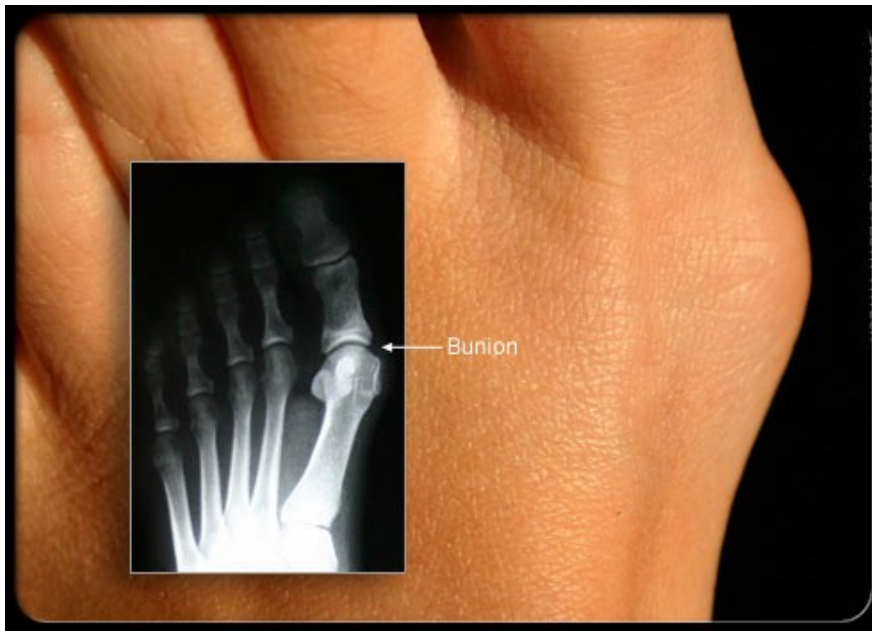
\*Vibration is Present if the examiner feels vibration on his finger joint for 10 seconds or less after the patient reports vibration at toe has stopped. Vibration is Reduced if examiner feels vibration for more than 10 seconds after patient reports vibration at toe has stopped. Vibration is Absent if patient does not perceive any vibration from the tuning fork.

Signature: \_\_\_\_\_ Total Score \_\_\_\_\_ /10 Points

## **Appendix B: FOOT ABNORMALITIES**

# Foot Abnormalities

## Bunion (Halux Valgus)



## Bunionette (Tailor's Bunion)



# Foot Abnormalities



Hammer Toe



Claw Foot Deformity



Charcot Arthropathy (rocker bottom)



# Dry Skin/Callus

## Dry skin/fissures



## Corn/Callus



# Athletes Foot Infection

## Athletes Foot



## Interdigital Athletes Foot



# “Other” Foot Inspection Findings

**Onychomycosis (Toenail Fungus)    Ingrown Toenail**



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# Ulcer

**Pressure ulcer associated with Charcot Arthropathy**

**Ulcer associated with pressure over the DIP joint of the great toe**



## Appendix C: MNSI GUIDANCE



July 30, 2014

Dear SEARCH MNSI EXAMINERS:

This note is to provide guidance for all sites with regard to how to report wounds and other “abnormalities” on the MNSI. This has been a source of ongoing concern by a number of examiners.

As a reminder, the purpose of the MNSI is to identify abnormalities of the foot that are highly correlated with peripheral neuropathy. This would include changes in foot structure (deformities such as bunions, Charcot arthropathy, claw foot deformities, hammer toes), skin integrity (significant callus, significant dry skin, fissures), edema, discoloration/mottling foot ulcers, reduced or absent ankle reflexes, reduced or absent distal vibration perception, and reduced or absent distal monofilament perception.

During the foot examination there will be, without doubt, abnormalities identified. However, it’s important to remember that not all abnormalities should be reported on the MNSI as they are not usually associated, or highly correlated with neuropathy. Common examples of abnormalities that should not be captured on the MNSI include blisters, rashes, moles, scars, skin discolorations, edema, birthmarks, and sores/scratches or other wounds related to incidental trauma (including trauma induced by ill-fitting shoes or going barefoot). I realize that this goes against the grain. But again, within the context of the MNSI, these should not be recorded as abnormalities. They may of course be recorded as clinically relevant findings in other source documents or clinical notes.

The determination of whether or not a wound rises to the level of a foot ulcer is another issue of concern. In order to provide better guidance, we are proposing the following definition of foot ulcer, which is based on the definition used for the DCCT/EDIC study.

*Ulcer is diagnosed when a traumatic or non-traumatic excavation or loss of subcutaneous tissue in the foot occurs with evidence of inflammation and/or infection that requires medical or surgical treatment by a health professional in an office or hospital setting. The “foot” is defined by all anatomic structure distal to the malleoli (e.g., everything below the ankle bone).*

We hope that this information is helpful to you. As always, thank you for your hard work and never hesitate to send an email or call with any questions you may have about the MNSI!

Sincerely,

A handwritten signature in black ink, appearing to read 'Catherine Martin'.

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