Continuing Medical Education

A Practical Update to Comprehensive Screening in the High-Risk Diabetic Foot

This exam gives you the most accurate assessment of this limb-threatening condition.

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Goals and Objectives

After reviewing this CME activity, the reader should be able to:

1) Identify the morbidity and global healthcare costs associated with DFUs.

2) Describe the comprehensive assessment of diabetic patients and their feet.

3) Evaluate a patient's risk factors and make an appropriate classification

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*Following this article, an answer sheet and full set of instructions are provided (pg. 140).—**Editor***

The lifetime risk of a person with diabetes developing a diabetic foot ulcer (DFU) is as high as 25%,[1] a diagnosis that precedes 84% of all non-traumatic diabetic lower extremity amputations.[2] In 2001 alone, diabetes-related foot ulcers and amputations cost the U.S. healthcare system an estimated $11 billion,[3] a cost that has risen to over $17 billion in 2013.[4] DFUs are among the most common complications of diabetes, with an-

Continued on page 130

Diabetic (from page 129)

nual recurrence rates reportedly as high as 34%, 61%, and 70% at 1, 3, and 5 years, respectively.[5,6]

DFUs are closely associated with decreased quality of life, and are an independent predictor of early mortality. Costs to treat diabetic patients with active ulcerations are 1.5 to 2.4 times that of those without an ulcer.[7] These costs inflate with the presence of peripheral arterial disease to nearly 4 times the cost of purely neuropathic wounds.[8] The addition of co-morbidities such as poor vascular status, poor nutritional status, and non-compliance to preventative therapies not only increases the cost of care and likelihood for hospital admission, but also greatly increases the likelihood for ulcerative recurrence requiring hospital admission.

Recently, removal of foot care reimbursements from a statewide Medicaid system led to significant and sustained increases in hospital admission (37%), charges (38%), length of stay (23%), and severe aggregate outcomes—including amputation, sepsis, and death (49%).[9] Therefore, preventing the initiation and recurrence of primary ulcerations through consistent and comprehensive lower extremity screening platforms should continue to be a significant priority to the healthcare community.[10,11]

2013 Costs to treat diabetes related foot ulcers and amputations in the U.S. healthcare system cost approximately $17 billion dollars.

This article is designed to be a self-study review for podiatric physicians interested in wound healing and care of diabetic feet. The text below outlines the standard management strategies in the assessment of diabetic feet with updates, including newer modalities for neuropathic testing and wound classifications.

Components of the Comprehensive Exam

Past Pertinent History

A review of the essential past relevant history is outlined in Table 1. A complete review of a patient's previous pertinent medical history is important in framing the findings of the physical exam. Key compo-

Continued on page 131

TABLE 1:

A Review of the Essential Past Relevant History

Review of Pertinent Podiatric History[12,13]	
History of	■ Ulceration, amputation, vascular surgery, or angioplasty
•	■ Cigarette smoking, poor medical management, suboptimal living conditions
•	■ Effectiveness of past therapeutic attempts
Neuropathic Considerations	■ Subjective: burning, shooting pain, electrical or sharp sensation
•	■ Objective: loss of protective sensation (LOPS)
Vascular Considerations	■ Claudication, rest pain, non-healing ulcer
Medical Comorbidities	■ End-stage renal disease, kidney dialysis or transplant
•	■ Visual blurring or impairment
•	■ Cardiovascular disease risk factors
•	—hypertension, hyperlipidemia, angina, myocardial infarction, strokes, peripheral vascular disease (PVD)

Vibratory perception threshold testing via a biothesiometer is considered to be the gold standard for neurologic sensation testing. A VPT > 25 is abnormal.

TABLE 2:
Essential Elements of the Dermatologic Inspection of the Lower Extremity

Dermatological Inspection[12,13]

- Skin: color, thickness, dryness, cracking
- Sweating: hyperhidrosis may contribute to increased skin breakdown
- Infection: check between toes for fungal infection
- Ulceration or minor lesions
- Corns, calluses, or blisters which may indicate dangerously high pressures

TABLE 3:
Essential Components of the Biomechanical Assessment of the Lower Extremity

Biomechanical Assessment [12,13]

Global inspection	■ Gross deformities, biomechanical limitations
•	■ Claw toes, hammer toes, severe bunions
•	■ Charcot Neuroarthropathy
Musculoskeletal Assessment	■ Ankle range of motion, great toe dorsiflexion and plantarflexion
•	■ Observe patient's ambulation

elements of the dermatologic inspection of the lower extremity. Careful inspection of the feet should be conducted at every patient visit, particularly in patients with a previous history of diabetes. Ill-fitting shoes, particularly those that are too small, are the leading cause of ulcerations in patients with DM.[15] It is therefore imperative that all patients have their most common footwear inspected at every visitation to ensure proper fit.[15] Shoes should be inspected respective to the patient's feet, with examples of inappropriate footwear including those that are excessively worn, sized too small (including those that may be too narrow, short, or have too low of toe box),[12] resulting in erythema, blister and callus from the rubbing.

Diabetic *(from page 130)*

nents of the history include a review of diabetes history, quality of glycemic control, loss of protective sensation (LOPS), neuropathic pain, and a history of previous ulceration, foot infection, or amputation.[13] Relevant foot-specific historical discussion must include a review of foot gear, callus formation, presence of foot deformities, and other factors leading to the initiation of the active wound.[12] Other important medical risk factors to review include peripheral vascular complications, cigarette smoking, impaired vision, symptoms of neuropathy or claudication, and co-morbidities such as end-stage renal disease, kidney dialysis, hypertension, angina, and peripheral vascular disease (PVD).[12,14]

General Inspection

Table 2 outlines the essential elements of the dermatologic inspection of the lower extremity. Careful inspection of the feet should be conducted at every patient visit, particularly in patients with a previous history of diabetes. Ill-fitting shoes, particularly those that are too small, are the leading cause of ulcerations in patients with DM.[15] It is therefore imperative that all patients have their most common footwear inspected at every visitation to ensure proper fit.[15] Shoes should be inspected respective to the patient's feet, with examples of inappropriate footwear including those that are excessively worn, sized too small (including those that may be too narrow, short, or have too low of toe box),[12] resulting in erythema, blister and callus from the rubbing.

Biomechanical Assessment

Essential components of the biomechanical assessment of the lower extremity are shown in Table 3. The musculoskeletal assessment includes the global inspection for gross deformities and biomechan-

4 sites per foot are tested per foot in the Ipswich Touch Test exam using a physician's index finger.

Continued on page 132

Diabetic (from page 131)

ical limitations. Deformities such as metatarsal phalangeal joint hyperextension with interphalangeal flexion (claw toes) or distal phalangeal extension (hammertoes) are commonly encountered forefoot deformities known to increase pressures on the plantar tissue.[14,16,17] These are often associated with advanced skin break-down leading to ulceration. Additionally, prominent metatarsal heads, protruding bones, or severely adducted hallux valgus deformities may increase acute shear forces on tissues increasing skin disturbance and wound development.

Assessment of joint mobility and range of motion around the joints should also be assessed, primarily plantarflexion and dorsiflexion of the ankles and great toes. It is also important to observe a patient's ambulation, as contributory factors such as decreased vision, gait imbalances, or knee and hip joint issues may demonstrate a need for assistive devices unperceivable from the lower extremity assessment alone. Additionally, assessing a patient's ability to see and reach their own feet is an important aspect to consider in the treatment plan.

Patients with diabetes should also be screened for Charcot arthropathy, typically presenting as a unilaterally red, hot, and swollen foot with a profound collapse of the midfoot.[18] Charcot arthropathies commonly lead to a rocker-bottom deformity of the midfoot, causing excessive peak plantar pressures, and drastically increasing the risk for ulceration.[14,19]

TABLE 4:

Essential Elements of the Neurologic Assessment of the Lower Extremity

Neurologic Assessment [12,13]	
Vibration Sensation	■ 128 Hz Tuning Fork — Abnormal if patient is unable to perceive vibration ■ Biothesiometer — VPT >25 V is abnormal
Touch Sensation	■ Pinprick — Inability to identify pinprick sensations over either hallux is abnormal ■ Monofilament — Loss of the ability to detect 10 grams of force perpendicular to the plantar tissue is associated with loss of large-fiber nerve function ■ Ipswich Touch Test
Ankle Reflexes	■ Achilles tendon reflex

Neurological Assessment

Essential elements of the neurologic assessment of the lower extremity are outlined in Table 4.

Vibration Sensation

Tuning Fork

A 128-Hz tuning fork is widely used in clinical practices for its inexpensive and rapid assessment of vibratory sensation. Intact sensation is tested over the dorsal tip of the hallux bilaterally, and is determined to be abnormal when the patient is unable to detect the vibratory sensation despite its perception by the physician administering the exam.[13]

Biothesiometer

Biothesiometry provides objective and reproducible assessments of vibration perception thresholds (VPT) at the dorsal hallux, and is regarded as the gold standard for assessing peripheral neuropathy in the clinic setting. This process should be repeated three times per site, with the mean of the three readings documented in the patient history. A VPT >25 V is regarded as abnormal and is one of the best predictors of long-term lower extremity complications.[20–22]

In the event of an initially absent Achilles tendon reflex the Jendrassik maneuver should be attempted to verify the results upon re-test.

Touch Sensation

Pinprick

The inability of a patient to perceive a sharp pinprick sensation is a direct parallel to the dangers present in one's daily environment. If a patient is unable to recognize sharp stimuli simulated in the office

Continued on page 133

Diabetic *(from page 132)*

setting, it is equally likely that this patient will be unable to detect offending and injurious objects in the external setting. Inability to identify pinprick sensations over either hallux indicates that patients are at a heightened risk of silent injury and should be regarded as an abnormal test result.[12]

Monofilament

10-gram monofilaments, also referred to as Semmes-Weinstein monofilaments, are well demonstrated to demonstrate a loss of pressure sensation, and to be predictive of ensuing ulceration.[23,24] Loss of the ability to detect 10 grams of force perpendicular to the plantar tissue is associated with loss of large-fiber nerve function. Proper selection of a monofilament is vital to this test's accuracy, as many commercially available have been determined to be imprecise.

It is recommended that at least four sites be tested on each foot, corresponding to the 1st, 3rd, and 5th metatarsal heads, and plantar surface of the distal hallux.[12] Patients are asked to close their eyes during testing, indicating a 'yes' or 'no' when asked whether the monofilament is being applied to the particular site. Physicians should document the areas where sensation is absent, being sure to avoid hypertrophic skin or areas of callus to ensure accurate pressure perception.

Ipswich Touch Test

In the absence of neurological instruments, many physicians resort to touching the feet with cotton swabs or their fingers to simulate the effect of a monofilament test. Researchers at the Ipswich hospital service in Suffolk UK took this examination one step further, formalizing a simple, quick, and easily taught procedure known as the Ipswich Touch Test (IpTT).[25]

The IpTT involves the physician lightly resting the tip of their index finger for one to two seconds on the tips of the first, third and fifth toes and the dorsum of the hallux. It is important that examiners not push, prod, or poke the skin, as this would elicit a perceptible sensation other than light touch. In this way, the IpTT has been found to have a similar sensitivity, specificity, and operating characteristic as the monofilament test, and direct comparison of the IpTT and monofilament showed near perfect concordance in results.[25,26]

The IpTT is simple, reliable, and quick, requiring no special instruments, is easily sterilized by hand-washing, necessitates little training and can be undertaken by nearly any healthcare staff member.[27] By removing all common barriers to testing, widespread implementation of the IpTT could drastically increase screening rates, particularly in community screening applications where funding, time, and equipment may be limited.

Incompressible calf or ankle arteries (ABI >1.3) should be re-tested using either digital arterial systolic pressure (toe pressure) or transcutaneous oxygen tension readings.

TABLE 5:

Essential Assessments of Vascular Status

Vascular Assessment [12,13]

- Palpation of Dorsalis Pedis and Posterior Tibial arteries
  - — Rated as either 'Present' or 'Absent' bilaterally
- Doppler ultrasound
- Ankle brachial index (ABI) pressure tests
  - ABI < 0.90 have findings consistent with symptoms of PAD
  - Incompressible or calcified arteries (ABI > 1.3) should be tested with other methods
  - To be repeated at least once every 5 years (for ADA risk classification tier 1)

Ankle Reflexes

Absence of intact ankle reflexes is an additional risk-factor for foot ulceration.[13] Ankle reflexes are to be tested with a reflex hammer, with the patient seated on the clinic table. The patient's foot should be dorsiflexed to a neutral position, stretching the Achilles tendon. It is then struck by the reflex hammer just proximal to insertion on the posterior calcaneus.[12] In the event of an absent response, the test should be repeated, with the patient performing a Jendrassik maneuver by interlocking cupped hands in front of the chest and attempting to pull them apart.[28]

An absent Achilles tendon reflex indicates pathology within the S1 and S2 nerve roots, possibly a result of sciatic nerve pathology or disk herniations at the L5 to S1 levels. A delayed response may classically be indicative of hypothyroidism, while a reduced ankle jerk reflex is a likely indicator of peripheral neuropathy.

Vascular Assessment

Essential assessments of vascular

Continued on page 134

Diabetic (from page 133)

status are shown in Table 5 (page 133). Peripheral arterial disease (PAD) is an ever-growing concern, currently affecting around 8.5 million Americans and a component of approximately one-third of foot ulcers.[12,29] PAD is a significant risk factor for recurrent wounds; therefore, the assessment of PAD is critical to the global evaluation of lower-extremity risk.[30]

Palpation of the posterior tibial and dorsalis pedis pulses are necessary, with descriptions as either 'present or absent' noted as such in the patient documentation.[31] Patients with signs or symptoms of vascular compromise in the lower extremity should be referred to vascular specialists for more in-depth inspection, specifically by ankle brachial pressure index (ABI) pressure testing and Doppler ultrasonic probing.[12] Current ADA consensus panel guidelines recommend measurement of ABIs in all patients with diabetes over the age of 50, at least every five years;[32] however, annual ABI testing may be a beneficial component of the annual comprehensive foot exam in patients with a history of PAD or other 'high-risk' factors.

Patients with absent pulses or an ABI < 0.90 have findings consistent with symptoms of PAD. It is important to note that in patients with significant calcinosis, ABI readings may be misleading as incompressible arteries result in falsely elevated or supra-systolic ankle brachial pressures. Therefore, incompressible calf or ankle arteries (ABI > 1.3) should be re-tested using either digital arterial systolic pressure (toe pressure) or transcutaneous oxygen tension readings.[12]

Laboratory Screening Tests

Hemoglobin A1C

Although a universal standard for all patients with diabetes mellitus may not be possible, current ADA guidelines recommend that all diabetic adults maintain an A1C level below 7%.[33] While there is little concrete evidence linking A1C levels to wound healing, rigorous maintenance of A1C levels to approximately 7% can reduce the risk of microvascular complications.[34,35]

Rigorous maintenance of A1C levels to approximately 7% can reduce the risk of microvascular complications.

Figure 1: A plantar diabetic ulceration is a serious threat to overall health.

Figure 2: The midfoot collapse of this chronic Charcot led to the development of an ulcerative wound.

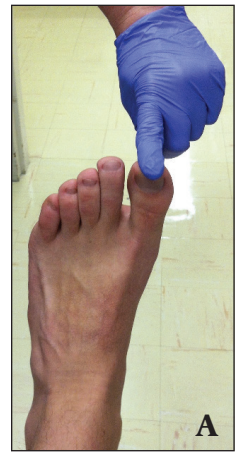

Figure 3: Digital assessment of the dorsalis pedis pulse (A), and posterior tibial pulse (B) should occur at every examination of the at-risk diabetic patient.

Hemoglobin A1C levels are an excellent gross assessment of a patient's overall glycemic control; therefore, HbA1C testing should be ordered if previous testing is more than four weeks old.

Nutritional Status

Patients at risk for DFUs should be assessed for nutritional status, as a poor diet and vitamin deficiency may decrease wound healing outcomes.[36] Prealbumin and/or albumin levels are a reasonable test to evaluate protein deficiency, and may provide additional nutritional information. Thyroid hormones continue to be linked to decreased metabolism, immune reactivity, and general health status.[37] Patients with thyroid dysregulation could be at an increased risk of recalcitrant or chronic wounds and should be evaluated for effective healing.

Many diabetic patients may have a previous history of, or may be at risk for, cardiovascular diseases, dyslipidemias and/or hypertension.[38] Therefore, a lipid profile (HDL, LDL, and cholesterol) is important in evaluating a patient's comprehensive potential for wound healing.

Vitamin D deficiency may play a role in the development of type 2 diabetes mellitus, peripheral neuropathy symptoms, and incident cardiovascular disease.[39–41] Additionally, patients with diabetes are also more likely to be both vitamin D deficient and have poorer bone quality, increasing their risk of injury during falls.[39,42] Combined vitamin D and calcium supplementation may be beneficial in optimizing glucose metabolism and reduce fractures in the high-risk patient.[41,42]

Neuropathic Contributions

A thorough differential diagnosis of LOPS should include the consideration of many conditions,

Continued on page 135

Diabetic (from page 134)

primarily hypothyroidism, vitamin B12 or thiamine deficiency, and other nutritional deficits, particularly those secondary to alcohol overuse.[43] Screening tests for comprehensive evaluation of contributing factors to patient neuropathy should include a complete blood count, sedimentation rate, and levels of vitamin B12, thyroid stimulating hormone, protein electrophoresis, homocysteine, and methylmalonic acid.[43]

Figure 4: Significant claw toes present great risk to patients, as bony biomechanical protrusions increase the shear forces against the skin.

Risk Classification and Referral Priority

Table 6 (page 136) presents a review of the risk stratification system, with suggested treatment recommendations and follow-up schedules as defined by the American Diabetes Association (ADA). The goal of screening and assessing the risk status of the diabetic patient is to generate an appropriate treatment plan based on the risk-factors present. Categories of risk are defined by the American Diabetes Association (ADA) to direct referral priority and subsequent therapies.

The WIFI risk classification system is based on the severities of ischemia, size/depth, and infection.

Wound Ischemia and Foot Infection (WIFI) Protocol

First reported in 1982, critical limb ischemia was defined as an ankle pressure < 40mm Hg in the presence of rest pain, and < 60 mm Hg in the presence of tissue necrosis.[45] However, improved understanding of the underlying disease states has proven that these hard values are no longer diagnostic for the majority of patients; rather, varying degrees of 'ischemia' are often present depending on other external factors governing the overall health of the limb. The concept of a critically ischemic limb preventing wound healing is therefore dependent on not only the degree of ischemia present, but also the depth of a wound and presence of infection.[46]

The wound, ischemia, and foot infection (WIFI) classification system was created to merge existing classification systems focused on diabetic foot wounds with ischemic models focused on lower extremity perfusion. The WIFI classification system grades each of these two risk factors and the severity of infection on a scale from 0 to 3, where 0 represents absent, 1 mild, 2 moderate, and 3 severe.[46] In basing risk stratification on the three major factors that impact amputation risk and clinical management of the diabetic wound, the WIFI classification system best informs physicians on the risks of amputation and need for revascularization in their patients by stratifying them into one of four stages of patient risk.

Current ADA guidelines recommend that all patients over the age of 50 in the 1st risk category receive ABIs every 5 years.

Diet, Lifestyle, and Socio-Mechanics

Patients should be questioned about unintentional weight changes greater than 10 pounds over the past six months, recurrent diarrhea, alcohol, or tobacco intake, use of dietary supplements or over-the-counter vitamins, consistent access to nutritious meals, and morning glucose levels. These questions may reveal dangerous

Continued on page 136

FIGURE 5

a, Estimate risk of amputation at 1 year for each combination

	Ischemia – 0				Ischemia – 1				Ischemia – 2				Ischemia – 3			
W-0	VL	VL	L	M	VL	L	M	H	L	L	M	H	L	M	M	H
W-1	VL	VL	L	M	VL	L	M	H	L	M	H	H	M	M	H	H
W-2	L	L	M	H	M	M	H	H	M	H	H	H	H	H	H	H
W-3	M	M	H	H	H	H	H	H	H	H	H	H	H	H	H	H
	fI-0	fI-1	fI-2	fI-3	fI-0	fI-1	fI-2	fI-3	fI-0	fI-1	fI-2	fI-3	fI-0	fI-1	fI-2	fI-3

Figure 5: The wound ischemia and infection (WiFI) classification system is a useful tool for estimating a patient's risk of lower extremity amputation. These charts divide patients into four categories or risk: Very low (VL), low (L), Medium (H), and High (H).

Diabetic (from page 135)

lifestyle behaviors which, if avoided, may lead to better healing rates. Additionally, research continues to explore the positive effects of physical activity in decreasing all-cause mortality, and continued active exercise should be widely advocated.[47–49]

Patient Education

Patient education is central to decreasing the number of diabetic amputations globally; thus, its importance in the overall treatment process should be reflected during patient care.[50] Consistent and repeated patient education may increase patient adherence to suggested home care behaviors, and has significantly improved patient outcomes in large-scale, randomized controlled trials.[51,52]

A lack of patient disease understanding and the benefits of consistent self-care are common barriers to wound treatment.[53] Absence of appropriate education regarding diabetes management was found to be a factor in over 90% of ulcer recurrence, emphasizing the necessity for repeated and continual education for the at-risk patient.[54,55]

Patient education is central to decreasing the number of diabetic amputations globally.

Additionally, reliance on home care may not always be implemented reliably. Patients in the high-risk patient subpopulation often experience additional cognitive impairment, visual loss, larger body sizes, or other co-morbidities, limiting their ability to assess the condition of their own feet.[56] In tandem with a lack of adequate patient disease education, this creates an extremely dangerous home situation with numerous obstacles preventing adequate wound healing. During the comprehensive examination into a patient's risk for injury and likelihood for wound healing, it is important to consider a patient's living situation, insurance access, daily activities, and family support.[57]

Conclusion

It cannot be stated enough that the complications secondary to diabetes mellitus are common, com-

Continued on page 137

TABLE 6:

A Review of the Risk Stratification System, with Suggested Treatment Recommendations and Follow-up Schedules as Defined by the American Diabetes Association (ADA)

Risk Category	Definition	Treatment Recommendations	Suggested Follow-up
3	■ History of ulcer or amputation	■ Same as category 1 ■ Consider vascular consultation for combined follow-up if PAD present	Every 1-2 months
2	■ PAD +/- LOPS	■ Consider prescriptive or accommodative footwear ■ Consider vascular consultation for follow-up	Every 2-3 months
1	■ LOPS +/- deformity	■ Consider prescriptive or accommodative footwear ■ Consider prophylactic surgery if deformity is not able to be safely accommodated in shoes ■ Continue patient education	Every 3-6 months
0	■ No LOPS, PAD, or deformity	■ Patient education including advice on appropriate footwear	Annually at minimum

Figure Legend: Peripheral arterial disease (PAD), loss of protective sensation (LOPS)

Diabetic *(from page 136)*

plex, and costly, requiring overwhelming resources from healthcare systems to manage. While the examination as described above may appear exhaustive and difficult to enact in the setting of a 15-minute patient exam, it should be noted that many of these screening tests happen simultaneously, with the most severe risk factors perceived within minutes of initiating patient interaction. It is only through systematic examination, appropriate risk-assessment with timely referral, and significant effort towards patient disease education that prompt reduction in morbidity of this high-risk patient population may be enacted. PM

A 75 year old female with a history of diabetes, LOPS, and an absent dorsalis pedis pulse would fall into ADA Category 2.

It is only through systematic examination, appropriate risk-assessment with timely referral, and significant effort towards patient disease education that prompt reduction in morbidity of this high-risk patient population may be enacted.

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Continued on page 138

Diabetic *(from page 137)*

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Dr. Giovinco is an Assistant Professor in the Department of Surgery at the University Medical Center, in Tucson, AZ for the University of Arizona. He has completed a foot and ankle surgical residency at Dekalb Medical, in Decatur, GA., and is a faculty member of the Podiatry Institute. He has published in areas of the foot and ankle literature for reconstruction, sports medicine, trauma, technology, as well as wound healing. His research endeavors include 3-D printing and eye-tracking, as well a number of other collaborations within the Makerspace community. He is also a clinical advisor to the interdisciplinary consortium of advanced motion performance (iCAMP). Dr. Giovinco is also the founder of a video podcast for Medical education at www.youtube.com/DrGlassDPM

John Miller is a third-year student at Des Moines University's College of Podiatric Medicine. John's academic interest focuses on diabetic limb salvage and research, having co-coauthored 12 posters abstracts at podiatric conferences and 5 manuscripts in peer-reviewed journals.

Continuing Medical Education

SEE ANSWER SHEET ON PAGE 141.

1) What is considered to be the gold standard for neurologic sensation testing?
- A) Vibratory perception threshold testing via a biothesiometer
- B) 128-Hz Tuning fork
- C) Pinprick Testing
- D) Ipswich Touch Test

2) At what level is a VPT finding abnormal?
- A) VPT > 5 is abnormal
- B) VPT > 10 is abnormal
- C) VPT > 18 is abnormal
- D) VPT > 25 is abnormal

3) How many specific points are tested per foot in the Ipswich Touch Test exam?
- A) 2 sites per foot
- B) 4 sites per foot
- C) 6 sites per foot
- D) 8 sites per foot

4) Conducting an Ipswich Touch Test requires which of the following equipment?
- A) Tuning Fork
- B) Biothesiometer
- C) 10-g Semmes-Weinstein monofilament
- D) Physician's index finger

5) In the event of an initially absent Achilles tendon reflex, which maneuver should be attempted to verify the results upon re-test?
- A) Trendelenburg maneuver
- B) Jendrassik maneuver
- C) Romberg's maneuver
- D) Kocher maneuver

6) 2013 costs to treat diabetes-related foot ulcers and amputations in the U.S. healthcare system cost approximately _____.
- A) $500 million
- B) $3 billion
- C) $9 billion
- D) $17 billion

7) As part of the foot ulcer examination, healthcare teams should_____.
- A) Assess dermatologi changes in the skin and musculoskeletal deformities
- B) Assess for co-morbidities such as end-stage renal disease, visual blurring, or impairment, and cardiovascular risk factors such as hypertension or angina
- C) Assess for vascular patency by grading the posterior tibial and dorsalis pedis arteries
- D) All of the above

8) Which of the following Ankle Brachial Index (ABI) value falls within an expected normal range?
- A) 1.4
- B) 1.1
- C) 0.8
- D) 0.4

9) Which of the following is closest to the ADA recommended adult hemoglobin A1c levels?
- A) 9%
- B) 8.5%
- C) 7%
- D) 5.5%

10) Which of the following may contribute to the development of LOPS (loss of protective sensation)?
- A) Hypothyroidism
- B) Vitamin B12 deficiency
- C) Thiamine Deficiency
- D) All of the Above

11) According to ADA guidelines, a patient with the following symptoms would occupy which Risk Category?: "75 year old female with a history of diabetes, LOPS, and an absent dorsalis pedis pulse."
- A) 0
- B) 1
- C) 2
- D) 3

12) The WIFI risk classification system is based on the severities of which three risk criteria?
- A) ischemia, size/depth, infection
- B) infection, size/depth, duration of wound persistence
- C) size/depth, wound odor, ischemia
- D) infection, duration of wound persistence, odor

13) Current ADA guidelines recommend that all patients over the age of 50 in the 1st risk category receive ABIs at minimum intervals of how many years?
- A) 1
- B) 5
- C) 7
- D) 10

14) Which of the following are benefits of using the Ipswich Touch Test to assess sensation perception?
- A) Requires no additional equipment
- B) Is rapidly administered
- C) Is constantly available
- D) All of the above

15) Classic characteristics of a Charcot neuroarthropathy include_____.

Continued on page 140

A) Bilateral presentation
B) Cool, cyanotic skin
C) Achilles tendon laxity
D) Red, warm, edematous midfoot

16) Which of the following are necessary components of a comprehensive biomechanical assessment?
A) Gross deformities and biomechanical limitations
B) Claw toes, hammertoes, and painful bunions
C) Active Charcot neuroarthropathy
D) All of the above

17) Which of the following is suggested, as a frequency of vibration sensation testing?
A) 64-Hz tuning fork
B) 128-Hz tuning fork
C) 192-Hz tuning fork
D) 256-Hz tuning fork

18) Which of the following statements is true?
A) The lifetime risk of a person with diabetes developing a foot ulcer is as high as 25%.
B) Diabetic foot ulcers precede ~84% of all non-traumatic diabetic lower extremity amputations.
C) Costs to treat diabetic patients with active ulcerations are 1.5 to 2.4 times that of those without an active ulceration.
D) All of the above.

19) Examples of inappropriate footwear for the at-risk diabetic patient include ___.
A) Shoes that are too small in size
B) Shoes that are overly narrow
C) Shoes with a small toe box
D) All of the above

20) Factors increasing risk of vascular compromise include ____.
A) Claudication or rest pain
B) Smoking
C) ABI values > 1.3
D) All of the above

SEE ANSWER SHEET ON PAGE 141.

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EXAM #2/15
A Practical Update to Comprehensive Screening in the High-Risk Diabetic Foot (Giovinco and Miller)

Circle:

1.	A	B	C	D	11.	A	B	C	D
2.	A	B	C	D	12.	A	B	C	D
3.	A	B	C	D	13.	A	B	C	D
4.	A	B	C	D	14.	A	B	C	D
5.	A	B	C	D	15.	A	B	C	D
6.	A	B	C	D	16.	A	B	C	D
7.	A	B	C	D	17.	A	B	C	D
8.	A	B	C	D	18.	A	B	C	D
9.	A	B	C	D	19.	A	B	C	D
10.	A	B	C	D	20.	A	B	C	D

Medical Education Lesson Evaluation

Strongly agree [5]	Agree [4]	Neutral [3]	Disagree [2]	Strongly disagree [1]

1) This CME lesson was helpful to my practice ____

2) The educational objectives were accomplished ____

3) I will apply the knowledge I learned from this lesson ____

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5) This lesson presented quality information with adequate current references ____

6) What overall grade would you assign this lesson?

A B C D

How long did it take you to complete this lesson?

_____hour _____minutes

What topics would you like to see in future CME lessons ?

Please list :

_____

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