Diabetic foot

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Diabetic foot

Infection, ulceration or destruction of tissues of the foot associated with neuropathy and/or peripheral artery disease in the lower extremity of a person with (a history of) diabetes mellitus.

IWGDF

Diabetic foot is a disease complex that can develop in the skin, muscles, or bones of the foot because of nerve damage, poor circulation and/or infection that is associated with diabetes

Diabetic foot/ Major Foot Complications

Diabetic foot/ Minor Foot Complications

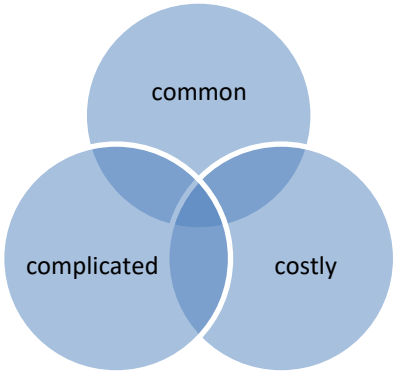
Diabetic foot/prevalence of ulcerations

- The prevalence of foot ulcerations among diabetics 1% in certain European and North American studies rises to more than 11% in reports from some African countries IDF 2017
- lifetime risk of a person with diabetes developing a foot ulcer could be as high as 25-30%

Singh et al, . JAMA 2005; 293: 217–28

- 50% of ulcers develop infection
- 17% of infected ulcers will require amputation
- 40% will recure in 1 year

Armstrong DG, Boulton AJM, Bus SA. Diabetic foot ulcers and their recurrence. N Engl J Med. 2017;376(24):2367–2375.

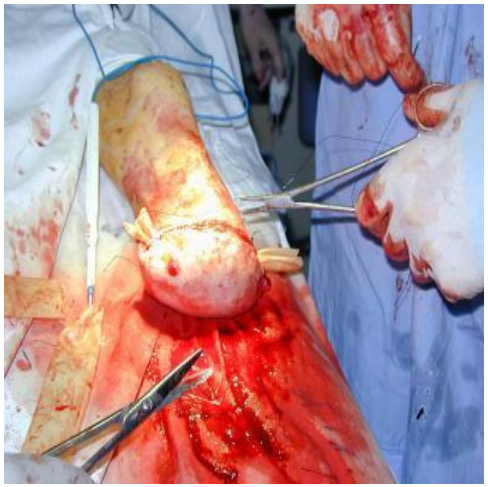


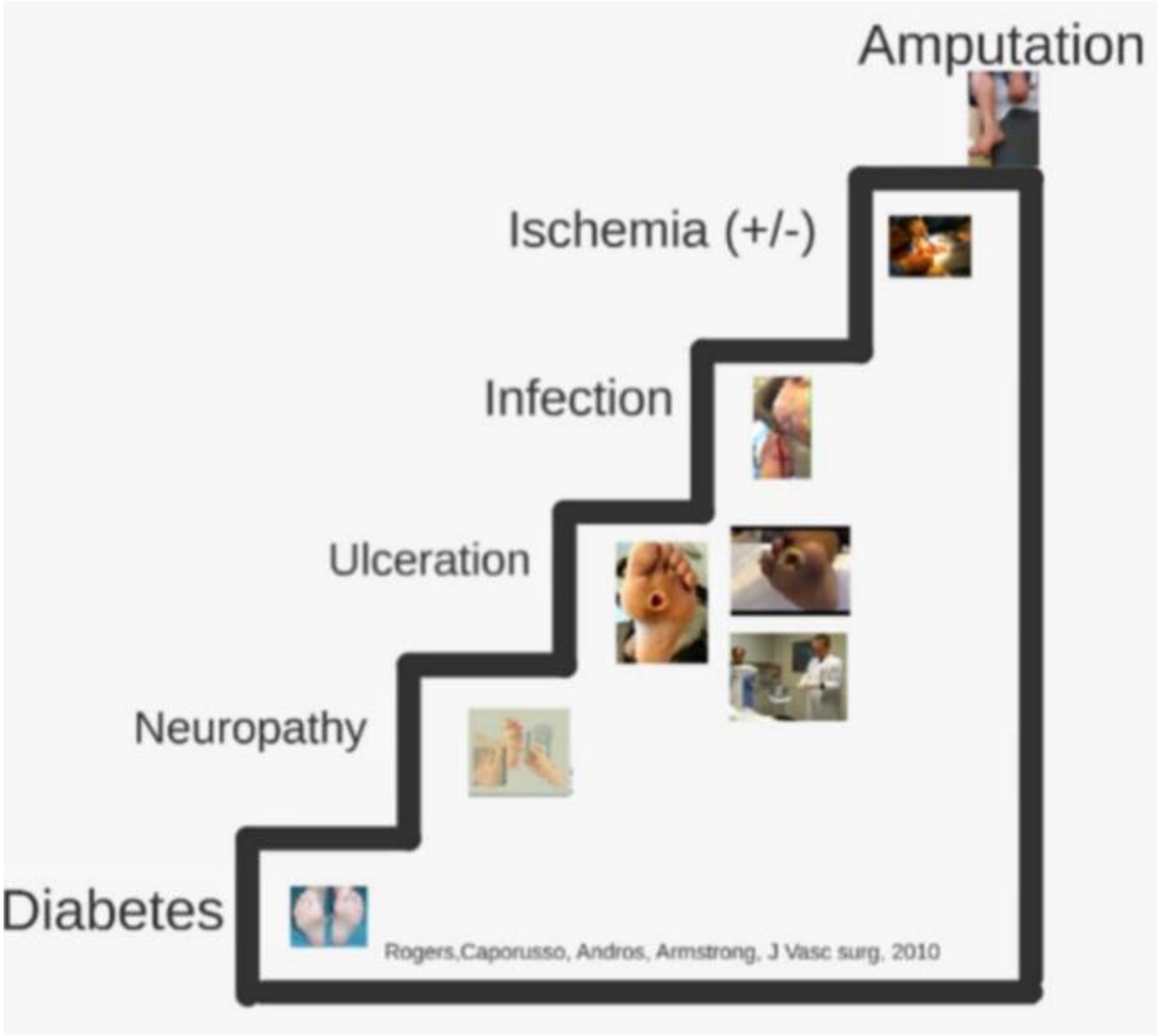
Diabetic foot ulceration

one of the most serious complications of diabetes

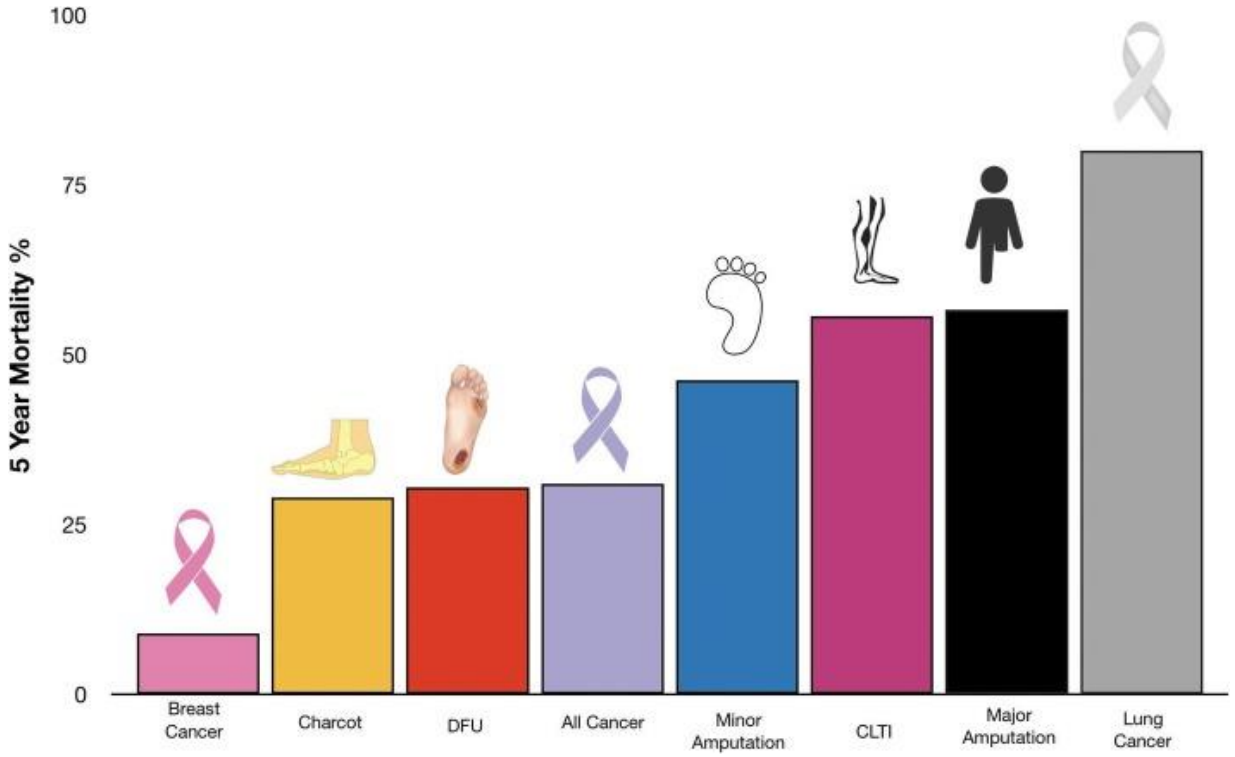
- Foot ulcers cause
  - Substantial morbidity
  -Impair quality of life
  -High treatment costs
    - 80 billion in US in the year 2017
  -The most important risk factor for lower-extremity amputation
- Every 15-20 seconds a lower limb is lost somewhere in the world because of diabetes
- 537million adults 20-79 years are living with diabetes
- 6.7 million diabetes related death
- 1 in 6 adults in middle east and north Africa have diabetes

2021 IDF




Amputation
Ischemia (+/-)
Infection
Ulceration
Neuropathy
Diabetes
Rogers,Caporusso, Andros, Armstrong, J Vasc surg, 2010

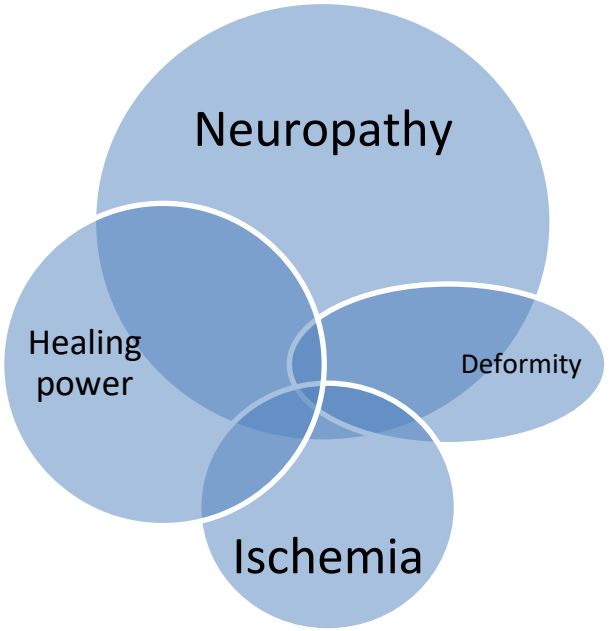
Diabetic foot ulceration/mortality



Armstrong DG, Swerdlow MA, Armstrong AA, Conte MS, Padula WV, Bus SA. Five year mortality and direct costs of care for people with diabetic foot complications are comparable to cancer. J Foot Ankle Res. 2020 Mar 24;13(1):16

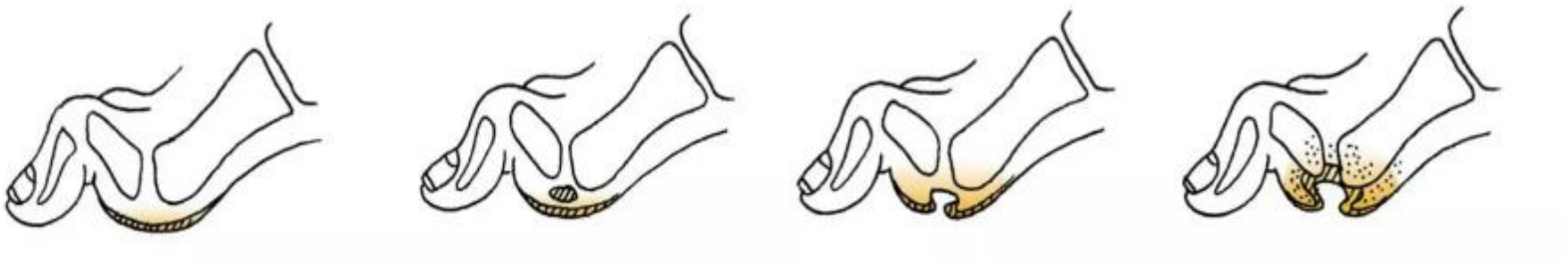
Diabetic foot/Etiology

- Neuropathy
- Ischemia
- Deformity
  - abnormal foot structure and biomechanics
- Weak healing power



Diabetic foot/peripheral neuropathy

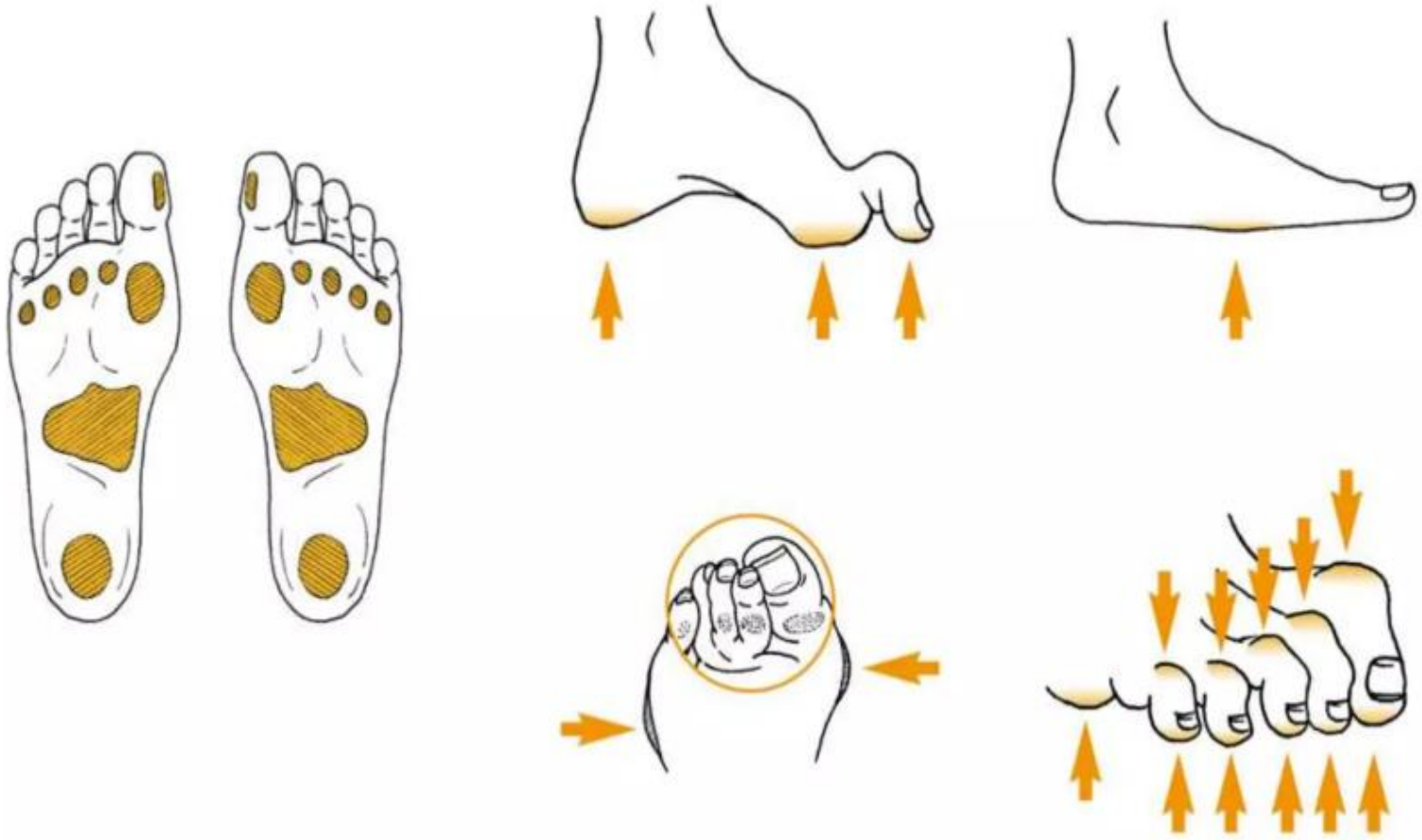
The presence of symptoms or signs of peripheral nerve dysfunction in people with diabetes, after exclusion of other causes



Diabetic foot/peripheral neuropathy

- Sensorimotor & peripheral sympathatic neuropathy are major risk factors for ulceration
- Up to 50%of type2 diabetic patient have significant neuropathy & at risk of foot ulcer
- Up to 50% of patients may experience symptoms, most frequently a burning pain, electrical or stabbing sensations, paresthesia, hyperesthesia, and a deep aching pain

Diabetic foot/highest risk for ulceration



Diabetic foot/peripheral neuropathy-diagnosis

Diagnostic tests for Diabetic Peripheral Neuropathy include:

Vibration perception tested with tuning fork

Monofilament screening test

Nerve conduction velocity measurements

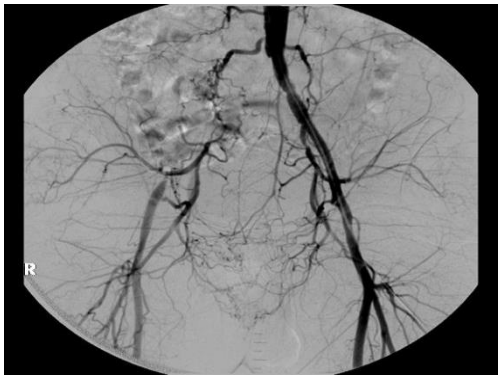
Diabetic foot/peripheral vascular disease

- Obstructive atherosclerotic vascular disease with clinical symptoms, signs or abnormalities on non-invasive vascular assessment, resulting in disturbed or impaired circulation in one or more extremities

2015 International Working Group on the Diabetic Foot

Diabetic foot/peripheral vascular disease

- Large vessel disease
  - Common both sex
  - early age of onset
  - rapid progression
- Microvascular disease
  - presence in limbs controversial
  - retinal and renal lesions common



Diabetic foot/peripheral vascular disease-assessment

- Subjective
  - Pain
  - rest pain
  - Claudication
  - Color changes
- Objective
  - Palpation of pulses
  - Doppler pressures (ankle/brachial index)
  - Noninvasive testing
  - Invasive testing

Diabetic foot/peripheral vascular disease assessment

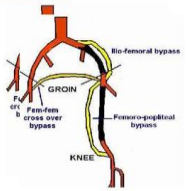
- In patients with a non-healing ulcer for more than 6 weeks
- when the toe pressure less than 30 mmHG or the TcPO2 less than 25 mmHG

consider vascular imaging and revascularization

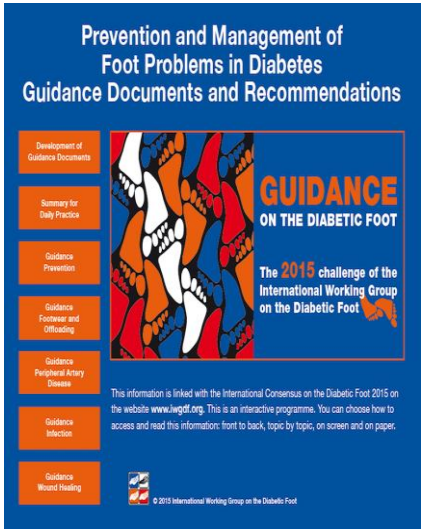
Strong; low Quality of evidence, IWGDF 2015

Strategies in treating patients with diabetic foot

Improve Lower Limb Circulation
- Conservative (Exercise Program)
- Intervention (Revascularization)
  - Angioplasty +/- Stenting
  - Surgical Bypass



Diabetic foot/EVM



International Diabetes Federation

IWGDF Guidance

IWGDF /2023 guidelines

- Prevention of foot ulcers in persons with diabetes (1)
- Classification of diabetes-related foot ulcers (2)
- Diagnosis and treatment of foot infection in persons with diabetes (3)
- Diagnosis and management of peripheral artery disease in persons with a foot ulcer and diabetes (4)
- Offloading foot ulcers in persons with diabetes (5)
- Interventions to enhance healing of foot ulcers in persons with diabetes (6)
- Acute Charcot neuro-osteoarthropathy (7)

Diabetic foot/prevention

There are five key elements to prevent foot ulcers:

1. Identify the person with an at-risk foot
2. Regularly inspect and examine the feet of a person at-risk for foot ulceration
3. Provide structured education for patients, their family and healthcare professionals
4. Encourage routine wearing of appropriate footwear
5. Treat risk factors for ulceration

Diabetic foot/Foot at Risk

Table 1. Diabetes foot ulcer risk classification IWGDF[2]

Criteria	Description
Group 0	no neuropathy, no deformity, no peripheral vascular disease(PVD)
Group 1	With neuropathy, without deformity or PVD
Group 2	With neuropathy, with deformity or PVD
Group 3	History of foot ulceration or lower extremity amputation

Risk Level	Foot Ulcer %/yr	% in clinics (diabetes clinics)
3: Prior amputation Prior ulcer	28.1% 18.6%	7%
2: Insensate *and* foot deformity or absent pedal pulses	6.3%	10%
1: Insensate	4.8%	17%-30%
0: All normal		

Education
Annual community screening

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2: Insensate *and* foot deformity or absent pedal pulses	6.3%	10%
1: Insensate	Education Regular podiatry & screening	
0: All normal	1.7%	66%

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0: All normal	1.7%	66%

Regular podiatry & screening
Footwear & insoles

Diabetic foot/how can we prevent ulcerations among patients with Foot at risk?

In a person with diabetes who has peripheral neuropathy, screen for:

1. history of foot ulceration or lower-extremity amputation
2. peripheral artery disease
3. foot deformity
4. pre-ulcerative signs on the foot
5. poor foot hygiene and ill-fitting or inadequate footwear

Strong; low Quality of evidence R2, IWGDF 2015

Diabetic foot/how can we prevent ulcerations among patients with Foot at risk?

Treat any pre-ulcerative sign on the foot of a patient with diabetes :

1. removing callus
2. protecting blisters and draining when necessary
3. treating ingrowing or thickened toe nails
4. treating hemorrhage when necessary
5. prescribing antifungal treatment for fungal infections.)

strong; low Quality of evidence R1, IWGDF 2015

Diabetic foot/how can we prevent ulcerations among patients with Foot at risk?

- Instruct an at-risk patient with diabetes to wear properly fitting footwear to prevent a first foot ulcer, either plantar or non-plantar, or a recurrent non-plantar foot ulcer.
- When a foot deformity or a pre-ulcerative sign is present, consider prescribing <u>therapeutic shoes, custom-made insoles, or toe orthosis</u>

strong; low Quality of evidence R6, IWGDF 2015

Diabetic foot/neuropathic ulcers

To heal a neuropathic plantar forefoot ulcer without ischemia or uncontrolled infection in a patient with diabetes, offload with a non-removable knee-high device with an appropriate foot-device interface

strong; high Quality of evidence, IWGDF 2015

Diabetic foot/ Infected neuropathic ulcers

Diabetic foot/infection

- Invasion and multiplication of microorganisms in host tissues that induces a host inflammatory response, usually followed by tissue destruction

Diabetic foot/assessment of foot ulcers

System	Characteristics
Wagner	▪ assesses ulcer depth along with the presence of gangrene and loss of perfusion using six grades (0 – 5)
Meggitt–Wagner	▪ assesses ulcers into three categories: infective, non-infective and mixed
University of Texas	▪ assesses ulcer depth, presence of infection and presence of signs of lower extremity ischemia using a matrix of four grades combined with four stages
PEDIS	▪ assesses perfusion, extent (size), depth (tissue loss), infection and sensation (neuropathy) using four grades (1 – 4)
SINBAD	▪ assesses site, ischemia, neuropathy, bacterial infection and depth; uses a scoring system to help predict outcomes and enable comparisons between different settings and countries

Diabetic foot/infection-severity

Table 2. Infectious Diseases Society of America and International Working Group on the Diabetic Foot Classifications of Diabetic Foot Infection

Clinical Manifestation of Infection	PEDIS Grade	IDSA Infection Severity
No symptoms or signs of infection	1	Uninfected
Infection present, as defined by the presence of at least 2 of the following items: • Local swelling or induration • Erythema • Local tenderness or pain • Local warmth • Purulent discharge (thick, opaque to white or sanguineous secretion)		
Local infection involving only the skin and the subcutaneous tissue (without involvement of deeper tissues and without systemic signs as described below). If erythema, must be >0.5 cm to ≤2 cm around the ulcer. Exclude other causes of an inflammatory response of the skin (eg, trauma, gout, acute Charcot neuro-osteoarthropathy, fracture, thrombosis, venous stasis).	2	Mild
Local infection (as described above) with erythema > 2 cm, or involving structures deeper than skin and subcutaneous tissues (eg, abscess, osteomyelitis, septic arthritis, fasciitis), **and** No systemic inflammatory response signs (as described below)	3	Moderate
Local infection (as described above) with the signs of SIRS, as manifested by ≥2 of the following: • Temperature >38°C or <36°C • Heart rate >90 beats/min • Respiratory rate >20 breaths/min or $PaCO_2$ <32 mm Hg • White blood cell count >12 000 or <4000 cells/μL or ≥10% immature (band) forms	4	Severe[a]

Abbreviations: IDSA, Infectious Diseases Society of America; $PaCO_2$, partial pressure of arterial carbon dioxide; PEDIS, perfusion, extent/size, depth/tissue loss, infection, and sensation; SIRS, systemic inflammatory response syndrome.

[a] Ischemia may increase the severity of any infection, and the presence of critical ischemia often makes the infection severe. Systemic infection may sometimes manifest with other clinical findings, such as hypotension, confusion, vomiting, or evidence of metabolic disturbances, such as acidosis, severe hyperglycemia, and new-onset azotemia [29, 43, 44].

Diabetic foot/ principles of treatment

1. Treatment of infection
2. Restoration of tissue perfusion
3. Pressure offloading and ulcer protection
4. Local ulcer care
5. Person Centered Care
6. Education for patient and relatives

Diabetic foot/infection-treatment

Diabetic Foot Infections

If patient does not have signs of sepsis, hold abx and get deep tissue or bone biopsy for Cx!

Severity	Empiric Rx (Representative agents)	Duration #
Mild	Clinda, Cephalexin, Amox-Clav, Doxy, TMP-SMX	1-2 wks, po
Moderate*	Amp-sulbactam, ertapenem, ceftriaxone, FQ + clinda	2-3 wks, +/- IV at start
Severe	MRSA coverage (vanc, linezolid, dapto) + GNR/anaerobic (pip-tazo or carbapenem or cefepime/flagyl)	2-3 wks, + IV at start

* Assess for risk factors for MRSA or PseA which may alter empiric Rx
# Presence of diabetic foot osteomyelitis will require longer duration

IDSA Diabetic Foot Infection Guidelines: CID 2012; 54(12)132-73.

Diabetic foot/healing issues

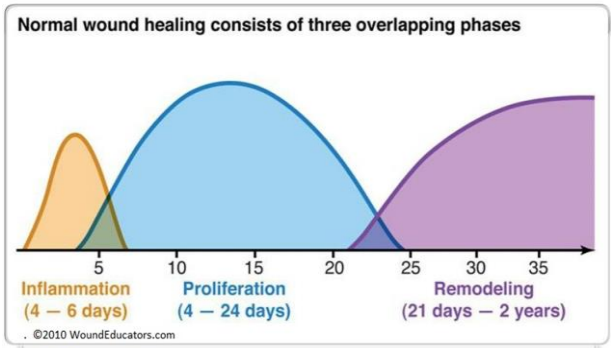
- Clean ulcers regularly with clean water or saline, debride when possible, in order to remove debris from the wound surface and dress them with a sterile, inert dressing in order to control excessive exudate and maintain a warm, moist environment in order to promote healing

Strong; low Quality of evidence, IWGDF 2015

Diabetic foot/healing issues-poor healing

Slow healing wounds = slow computers

- Multifactorial in origin
- Local tissue ischemia in addition to neuropathy impairs chemotaxis
- Tissue necrosis and infection prolongs the inflammatory phase of healing
- Uncontrolled periwound edema and wound instability disrupts myofibroblast
- Glycation of proteins
- Associated PVD



Indications for surgery in DF

- Emergency surgery
  - To limit progression of acute infection
    - Incision and drainage
    - debridement
  - To limit progression of acute ischemia
- Elective surgery
  - To promote healing
  - Vascular surgery
    - Skin surgery
- Prophylactic surgery
  - To treat joint stiffness
  - deformity

Diabetic foot/surgical debridement

Remove slough, necrotic tissue and surrounding callus with sharp debridement in preference to other methods, taking relative contra-indications such as severe ischemia into account

strong; low Quality of evidence, IWGDF 2015

Diabetic foot/Deformity-Charcot

- Neuro Osteoarthropathy
  - Ankle
  - Midfoot
  - Forefoot
  - Swelling, heat, and occasionally some redness to the foot with or without pain
- The incidence of Charcot 1.9 cases/1000 people with diabetes in Jordan

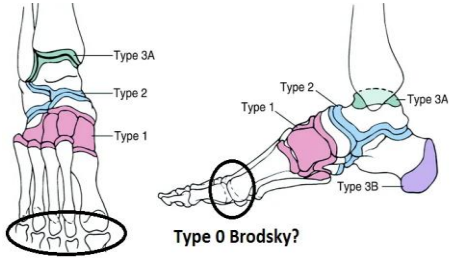
Clinical factors associated with Charcot foot. Mohammed Al Mousa, Mahmoud Al-Ardah, Jihad Al-Ajlouni, Nidal Youne. The Diabetic Foot Journal.2011, Vol 14, No 3, pages 124–129

Diabetic foot/Deformity-Charcot staging

Eichenholtz/Brodsky

Stage	Radiographic findings	Clinical findings	Treatment
0 (prodromal)	Normal radiographs	Swelling, erythema, warmth	Patient education, serial radiographs to monitor progression, protected weightbearing
I (development)	Osteopenia, fragmentation, joint subluxation or dislocation	Swelling, erythema, warmth, ligamentous laxity	Protected weightbearing with total contact casting or prefabricated pneumatic brace. Cast or brace should be used until radiographic resolution of fragmentation and presence of normal skin temperature (usually needed for 2–4 months).
II (coalescence)	Absorption of debris, sclerosis, fusion of larger fragments	Decreased warmth, decreased swelling, decreased erythema	Total contact casting, prefabricated pneumatic brace, Charcot restraint orthotic walker, or clamshell ankle-foot orthosis
III (reconstruction)	Consolidation of deformity, joint arthrosis, fibrous ankyloses, rounding and smoothing of bone fragments	Absence of warmth, absence of swelling, absence of erythema, stable joint ± fixed deformity	Plantigrade foot: custom inlay shoes with rigid shank and rocker bottom sole. Nonplantigrade foot or ulceration: débridement, exostectomy, deformity correction, or fusion with internal fixation.

Stages I-III described by Eichenholtz, Stage 0 added by Shibata et al. [21], because clinical signs of Charcot arthropathy were found to precede radiographic changes.



Type 0 Brodsky?

Diabetic foot/Deformity-Charcot management

- Acute phase: 0-3 months (acute, development-fragmentation).
  - Treatment must start as soon as possible.
  - The foot must be immobilized in a plaster cast or DH walker
  - Weight must be kept off the foot so you may need to use crutches or a wheelchair.
- Healing phase: 4-8 months (sub-acute, coalescence).
  - The bones are starting to heal and fuse back together.
  - Some weight can be put on the foot.
  - The foot must remain in the plaster cast or walking brace.
- Rehabilitation: 8 month+ (chronic)
  - Gradual Wight bearing.
  - special insoles and shoes that support the foot and allow for any changes that have occurred in the shape of the foot.
- Surgery is usually reserved for joint instability or severe deformity

Thanks!

Do you have any questions?