



بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ



Online training:

Principles of treating diabetic foot Ulcers and offloading methods



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TIME : 9-12 AM

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Diabetes Research Center,
Tehran University of Medical Sciences,
Iranian Scientific Association of orthotics and prosthetics



انجمن علمی
ارتوز و پروتز ایران



مرکز تحقیقاتی پای دیابتی
مرکز تحقیقات دیابت



دانشگاه علوم پزشکی و خدمات
بهداشتی درمانی ایران



جمعیت هلال احمر
معاونت بهداشت،
درمان و توانبخشی

بازآموزی آنلاین

اصول درمان زخم پای دیابتی وروش های آفلودینگ

برگزارکننده: معاونت بهداشت، درمان و توانبخشی
جمعیت هلال احمر جمهوری اسلامی ایران



با همکاری و پارتان ارتوز و پروتز دانشگاه علوم پزشکی ایران،
گروه تحقیقاتی پای دیابتی مرکز تحقیقات دیابت دانشگاه علوم پزشکی تهران،
انجمن علمی ارتوز و پروتز ایران

۱۳ مرداد ۱۴۰۰

با ۳ امتیاز بازآموزی جهت همکاران پزشکی،
ارتوز و پروتز



Diabetic Foot Ulcers

دکتر محمد رضا امینی


پژوهشگاه علوم غدد و متابولیسم

۱۳ مرداد ماه ۱۴۰۰

فهرست مطالب

- اپیدمیولوژی دیابت و پای دیابتی
- عوامل خطر بروز زخم پای دیابتی
- انواع زخم پای دیابتی
- طبقه بندی زخم پای دیابتی
- اصول درمان و روش های نوین زخم پای دیابتی

Epidemiology

Region	2017 (million)	2045 (million)	Increase
World	425	629	 48 %
Western Pacific	159	183	15 %
Europe	58	67	16 %
North America	46	62	35 %
South & Central America	26	42	62 %
Middle East & North Africa	39	67	72 %
South East Asia	82	151	84 %
Africa	16	41	156 %

8th Edition; IDF Diabetes Atlas: Global estimates of diabetes prevalence
for 2017 and projections for 2045

Epidemiology

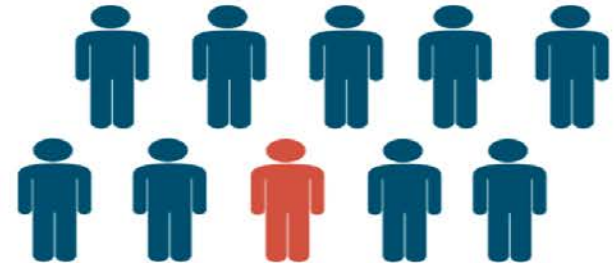
KEY MESSAGES

1 in 11 adults have diabetes (**415 million**)



KEY MESSAGES

By 2040, **1 adult in 10** (**642 million**) will have diabetes



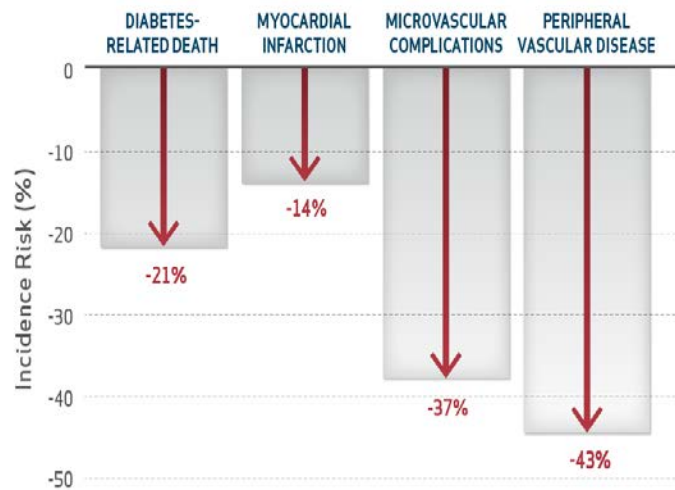
KEY MESSAGES

Every **6 seconds** a person dies from diabetes (**5.0 million deaths**)

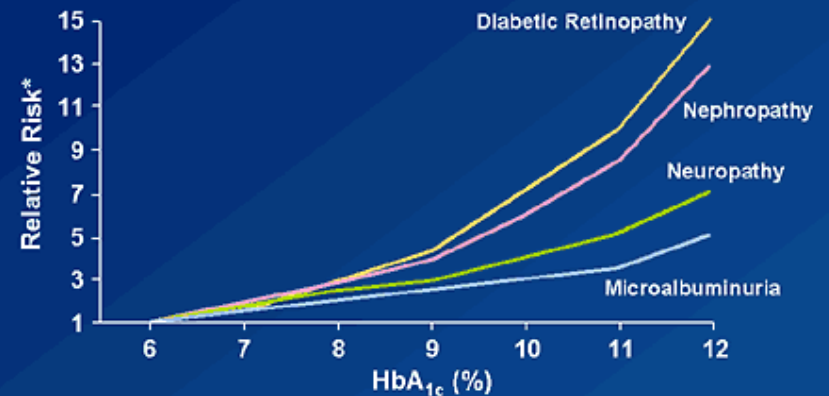


Diabetes & HbA1c

RISK REDUCTION BY LOWERING HbA1C BY 1%-POINT



Risk of Progression of Complications by HbA_{1c}: DCCT



* "Stylized" relative risk; relative risk set to 1 for HbA_{1c} of 6%
Skyler. *Endocrinol Metab Clin North Am.* 1996;25:243-254.

DF Epidemiology

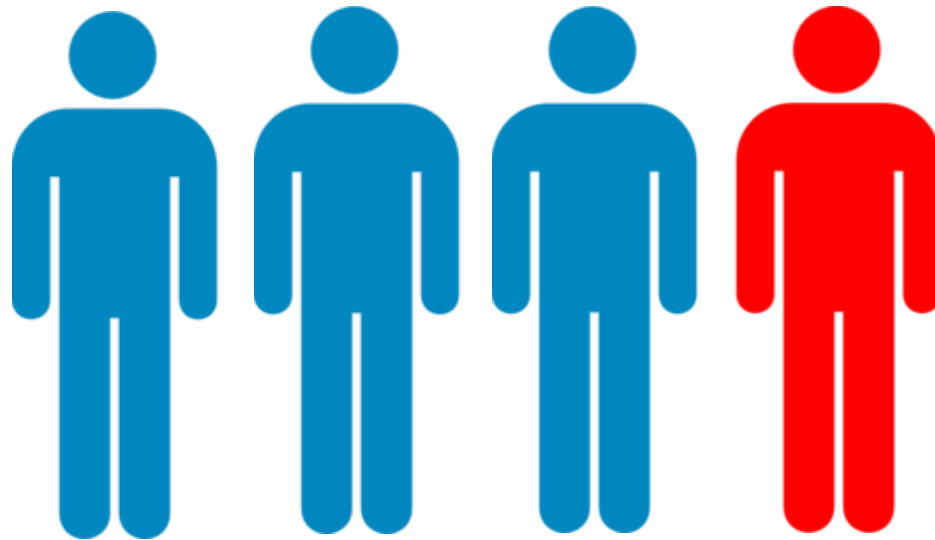
- Prevalence of foot ulcers is **4% - 10%**
- Incidence is **1.0% - 4.1%**
- Lifetime incidence may be as high as **25%**

[JAMA](#). 2005 Jan 12;293(2):217-28.

Preventing foot ulcers in patients with diabetes.

[Singh N](#), [Armstrong DG](#), [Lipsky BA](#).

One in every **four** patients with diabetes risk
developing a **DFU** in their lifetime



Preventing foot ulcers in patients with diabetes. [Singh N](#), et al. [JAMA](#). 2005 Jan 12;293(2):217-28.

Peripheral arterial disease (PAD) is present in **nearly 50%** of patients with diabetes.

Approximately 56% Of DFUs become infected.

About 20% of patients with an infected wound on the foot will undergo a lower extremity amputation.

- Pecoraro RE, Pathways to diabetic limb amputation. Basis for prevention. Diabetes Care. 1990 May;13(5):513-21.
- Prompers L et al. High prevalence of ischaemia, infection and serious comorbidity in patients with diabetic foot disease in Europe. Baseline results from the Eurodiale study. Diabetologia. 2007 Jan;50(1):18-25. Epub 2006 Nov 9
- Wu SC et al. Foot ulcers in the diabetic patient, prevention and treatment Vasc Health Risk Manag. 2007;3(1):65-76. Review

Globally, one leg is lost every

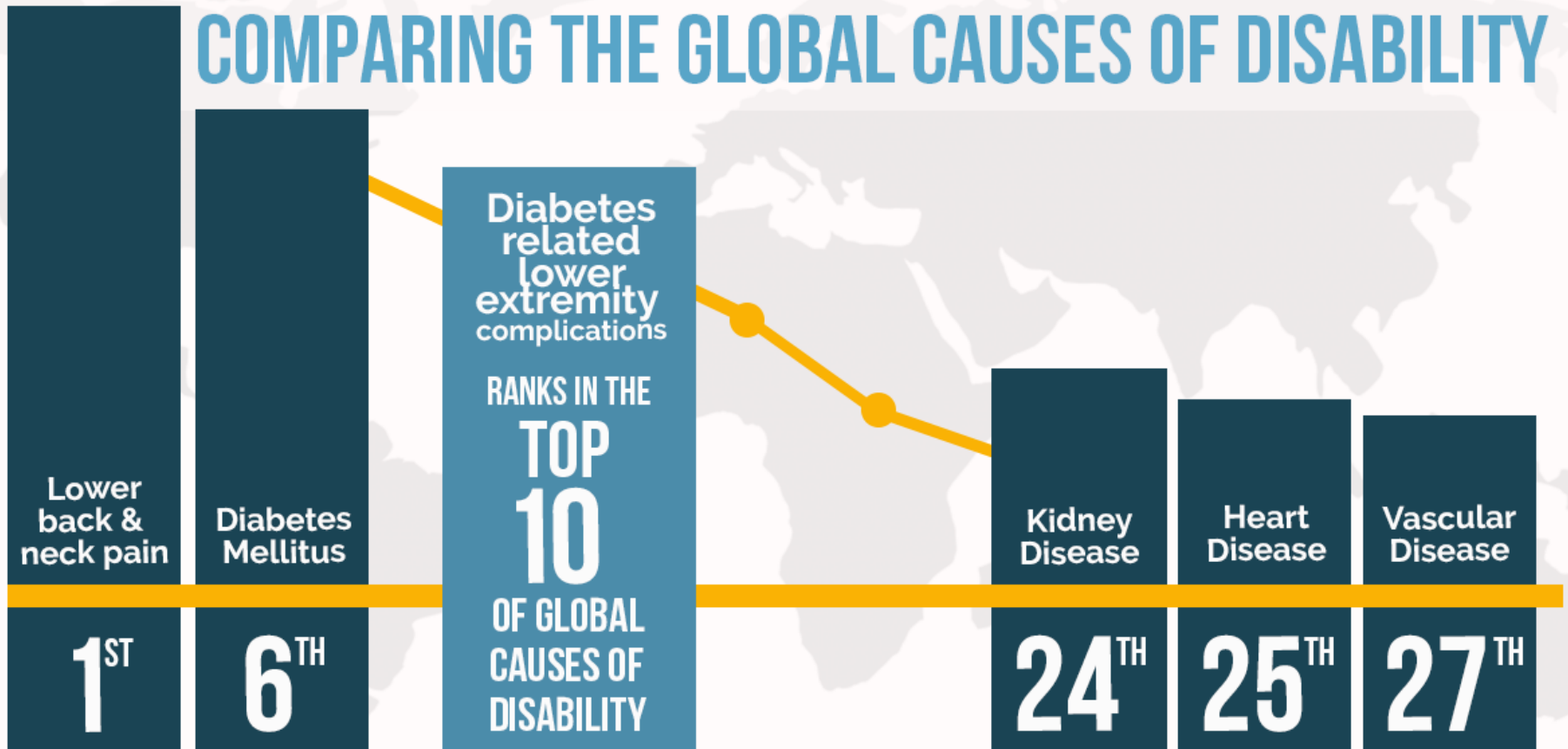
20 seconds

Because of diabetes



Hinchliffe RJ et al. Effectiveness of revascularization of the ulcerated foot in patients with diabetes and peripheral artery disease: a systematic review. International Working Group on the Diabetic Foot. Diabetes Metab Res Rev. 2016;32 Suppl 1:136-44

COMPARING THE GLOBAL CAUSES OF DISABILITY



Diabetes-related lower-extremity complications are a leading cause of the global burden of disability, P.A. Lazzarini. et al, 23 May 2018

Adults who died from diabetes, HIV/AIDS, tuberculosis, and malaria



5.0 million

from diabetes
2015
IDF



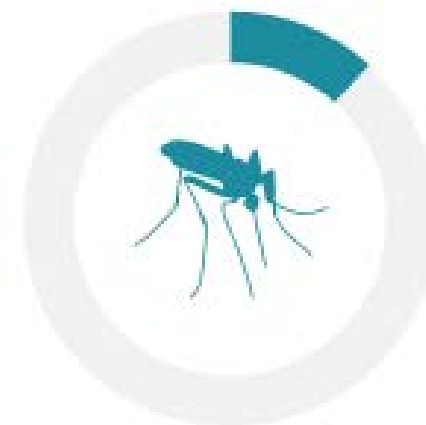
1.5 million

from HIV/AIDS
2013
WHO Global Health
Observatory Data
Repository 2013



1.5 million

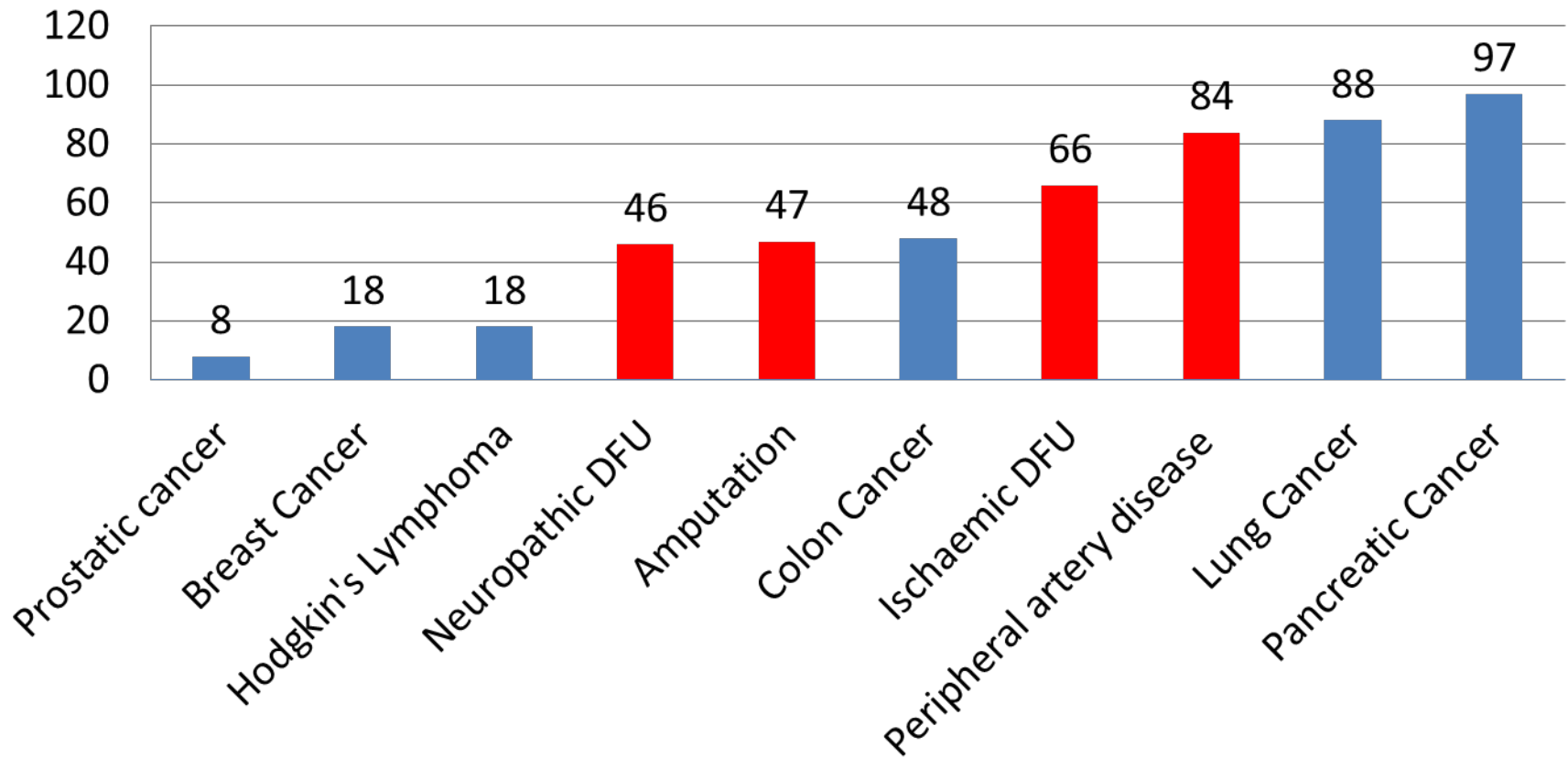
from tuberculosis
2013
WHO Global Health
Observatory Data
Repository 2013



0.6 million

from malaria
2013
WHO Global Health
Observatory Data
Repository 2013

Relative Five-year Mortality(%)



Up to 85%

of amputations can be avoided with
effective care plan

Definition

(based on WHO definition)

Infection, ulceration or destruction of deep tissues

associated with

neurological abnormalities &

various degrees of peripheral vascular diseases

in the lower limb.

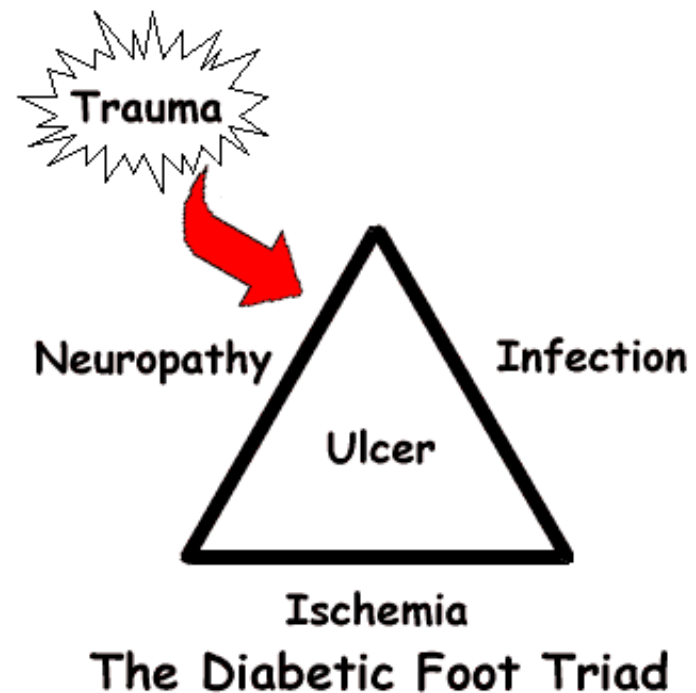
Etiology

- Three great pathologies come together in the diabetic foot:

–**Neuropathy**

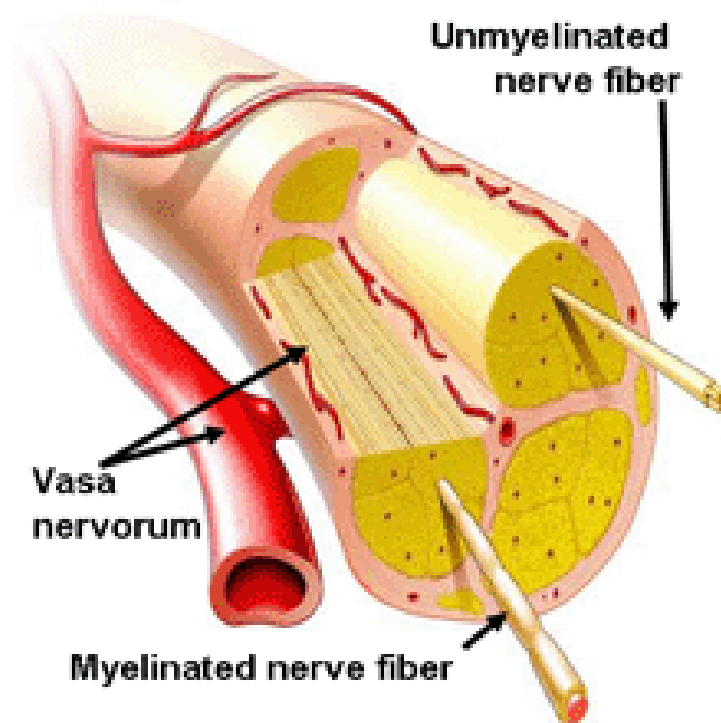
–**Ischemia**

–**Infection**

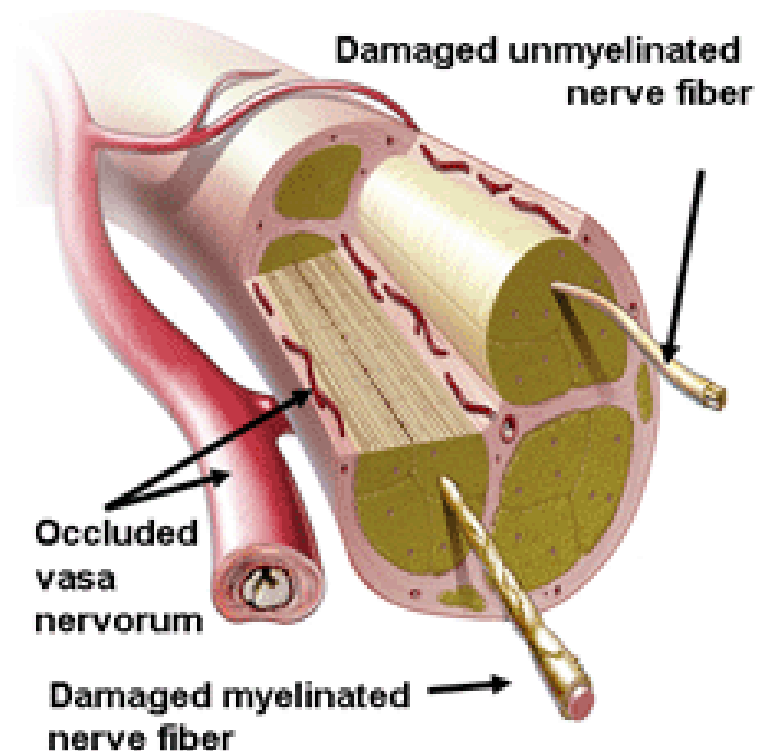


Diabetic Peripheral Neuropathy

Healthy Nerves and Blood Vessels



Nerves and Blood Vessels Damaged by DPN



Vinik AI. *Diabetic Microvascular Complications Today*. 2006;3:23-26.

General or systemic contributions

- Uncontrolled hyperglycemia
- Duration of diabetes
- Peripheral vascular disease
- Blindness or visual loss
- Chronic renal disease
- Older age

Local issues

- Peripheral neuropathy
- Structural foot deformity
- Trauma and improperly fitted shoes
- Callus
- History of prior ulcer amputation
- Prolonged elevated pressures
- Limited joint mobility

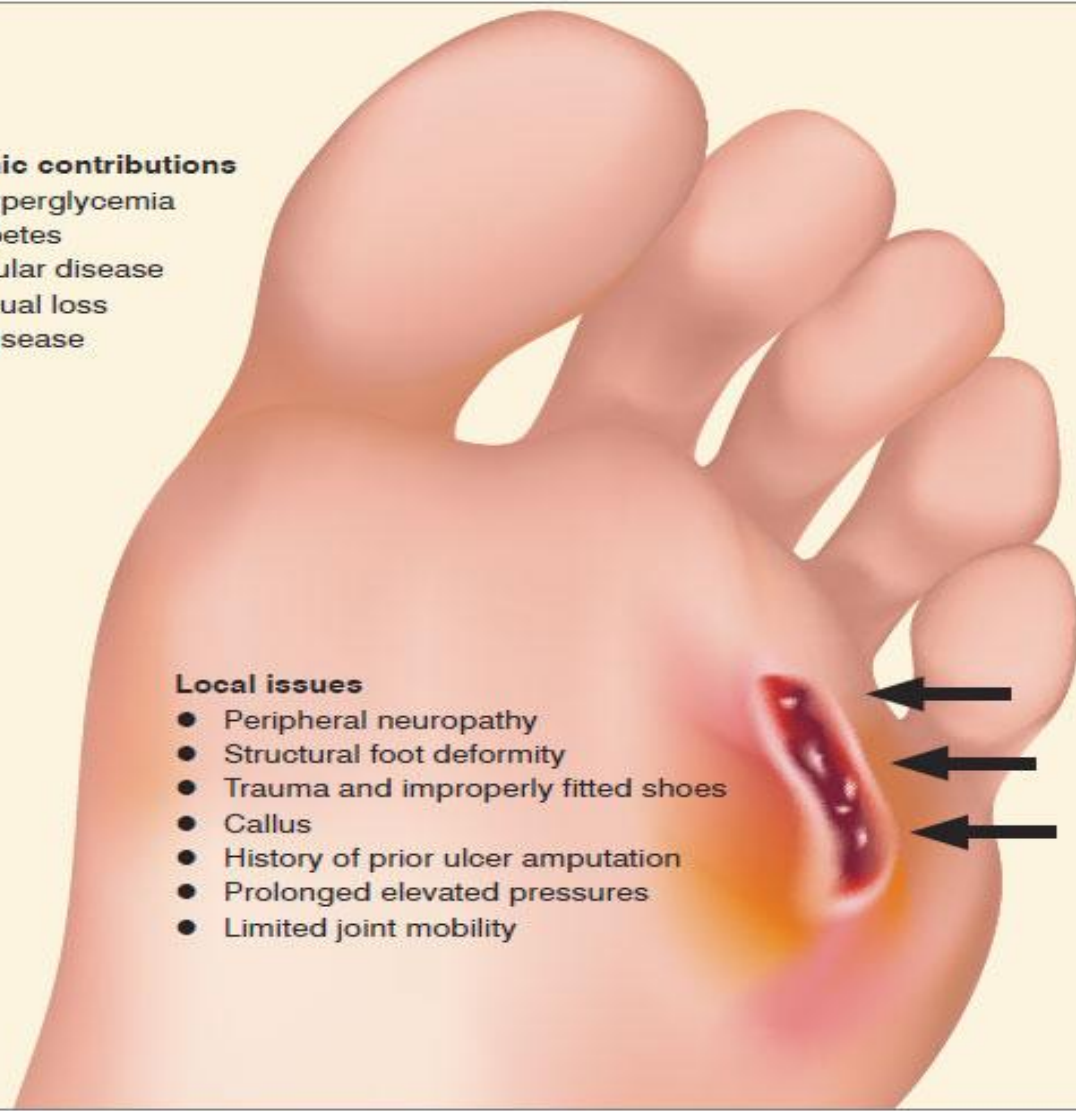


Figure 1: Risk factors for ulceration

Source: Adapted from The Journal of Foot and Ankle Surgery 2006;45(5 Suppl):S1-664

STAGES OF ULCER DEVELOPMENT



Fig 1. Illustration of ulcer due to repetitive stress



1. Callus formation



2. Subcutaneous hemorrhage



3. Breakdown of skin



4. Deep foot infection with osteomyelitis

TYPES OF DIABETIC FOOT ULCERS

Classification

- The diabetic foot can be classified into two groups:

☐ **Neuropathic foot** with palpable pulses

☐ **Ischaemic foot** without pulses and a varying degree of neuropathy

Types of Diabetic Foot Ulcers

- Neuropathic DFU
- Ischaemic DFU
- Neuroischemic DFU



Neuropathic



Ischaemic



Neuroischaemic

The neuropathic foot

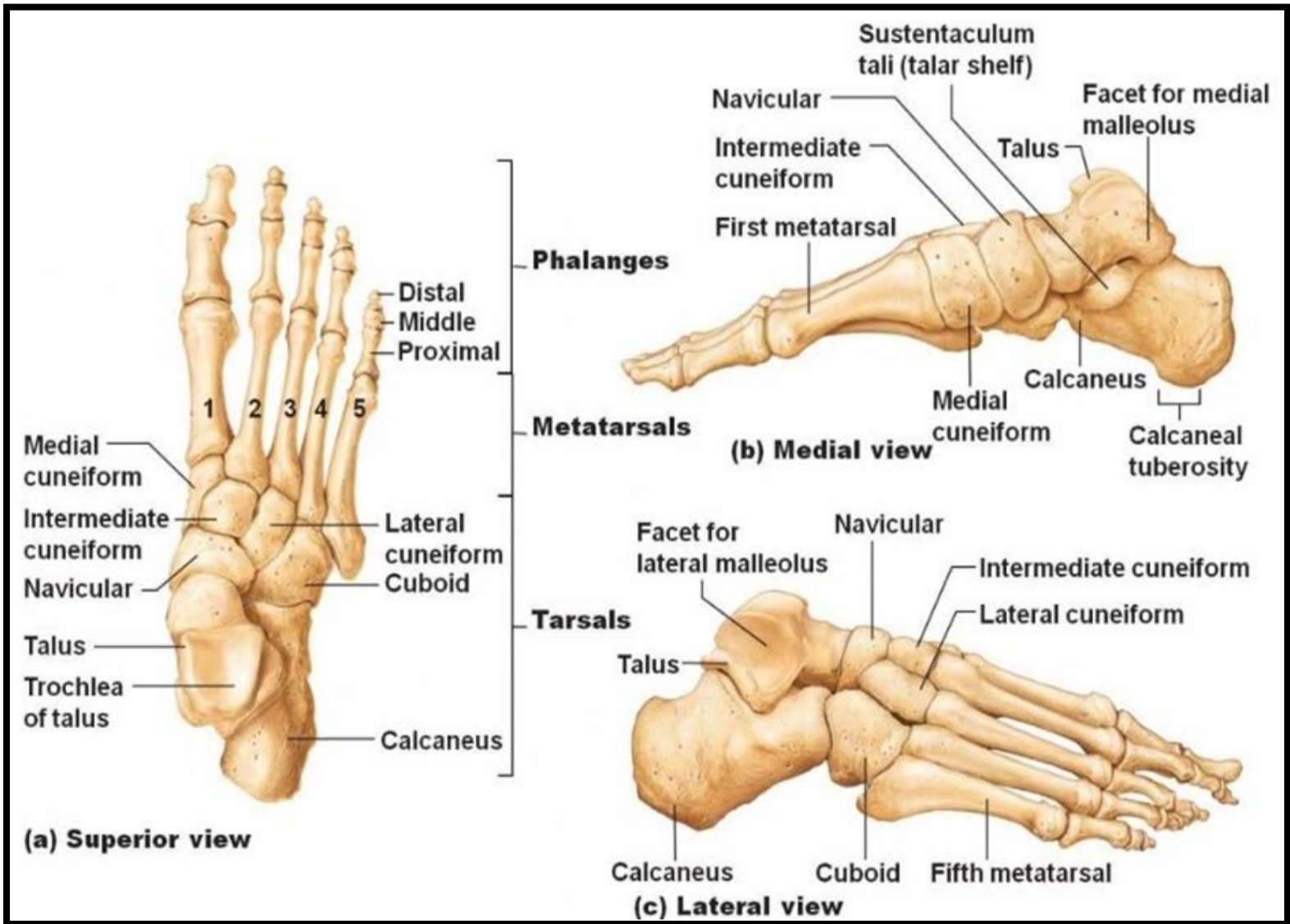
- The neuropathic foot may be further divided into two clinical scenarios:

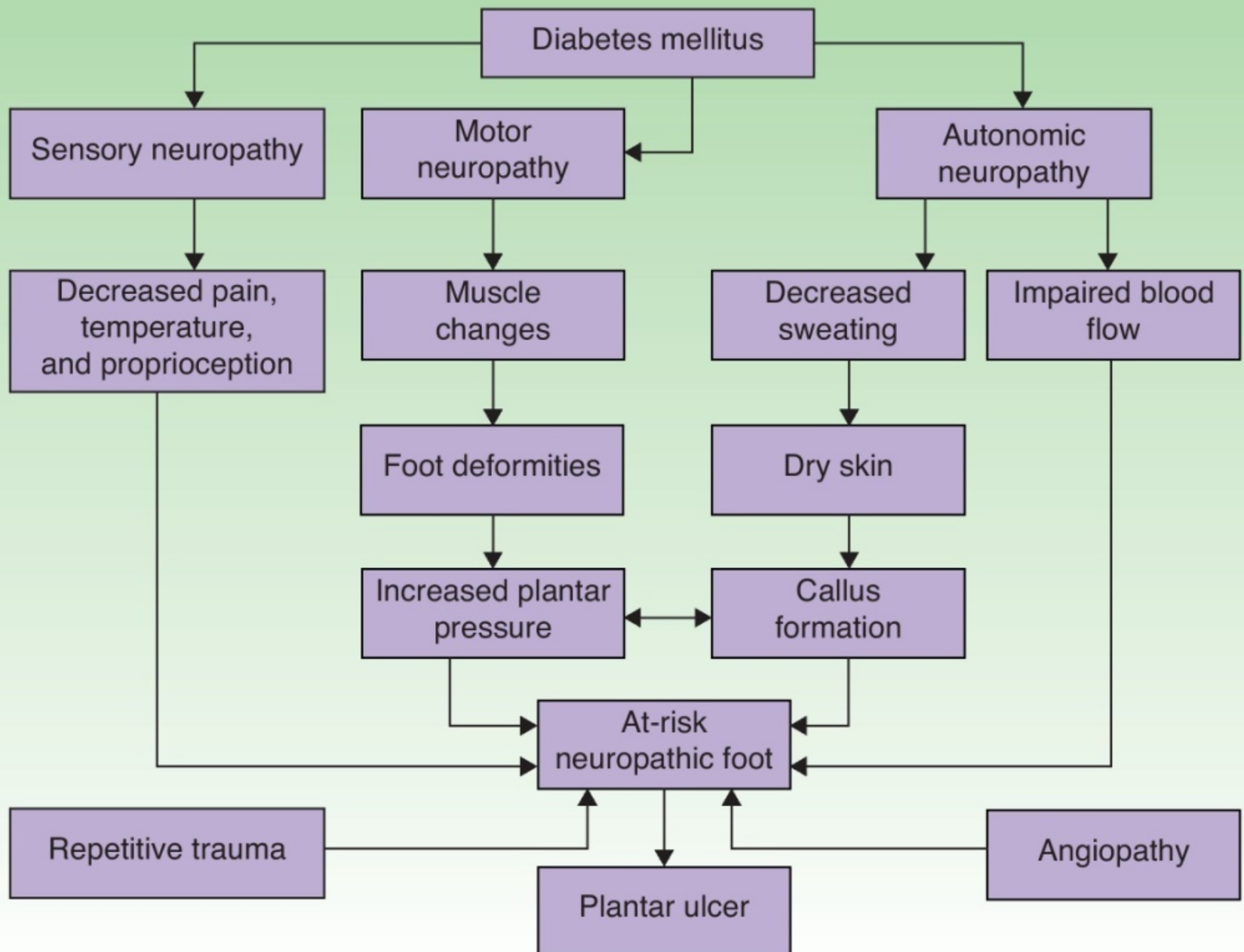
1. **Foot with neuropathic ulceration**



2. **Charcot foot, which may be secondarily complicated by ulceration**







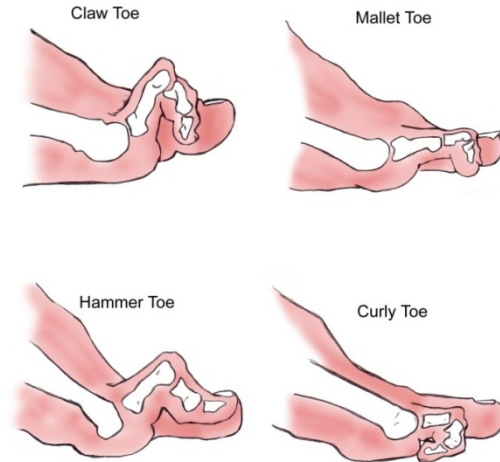
Sensory Neuropathy

- **Burning and tingling** sensation that becomes more Severe at night
- **Muscle cramps**
- **Lack or loss of feeling** in the lower extremities



Motor Neuropathy

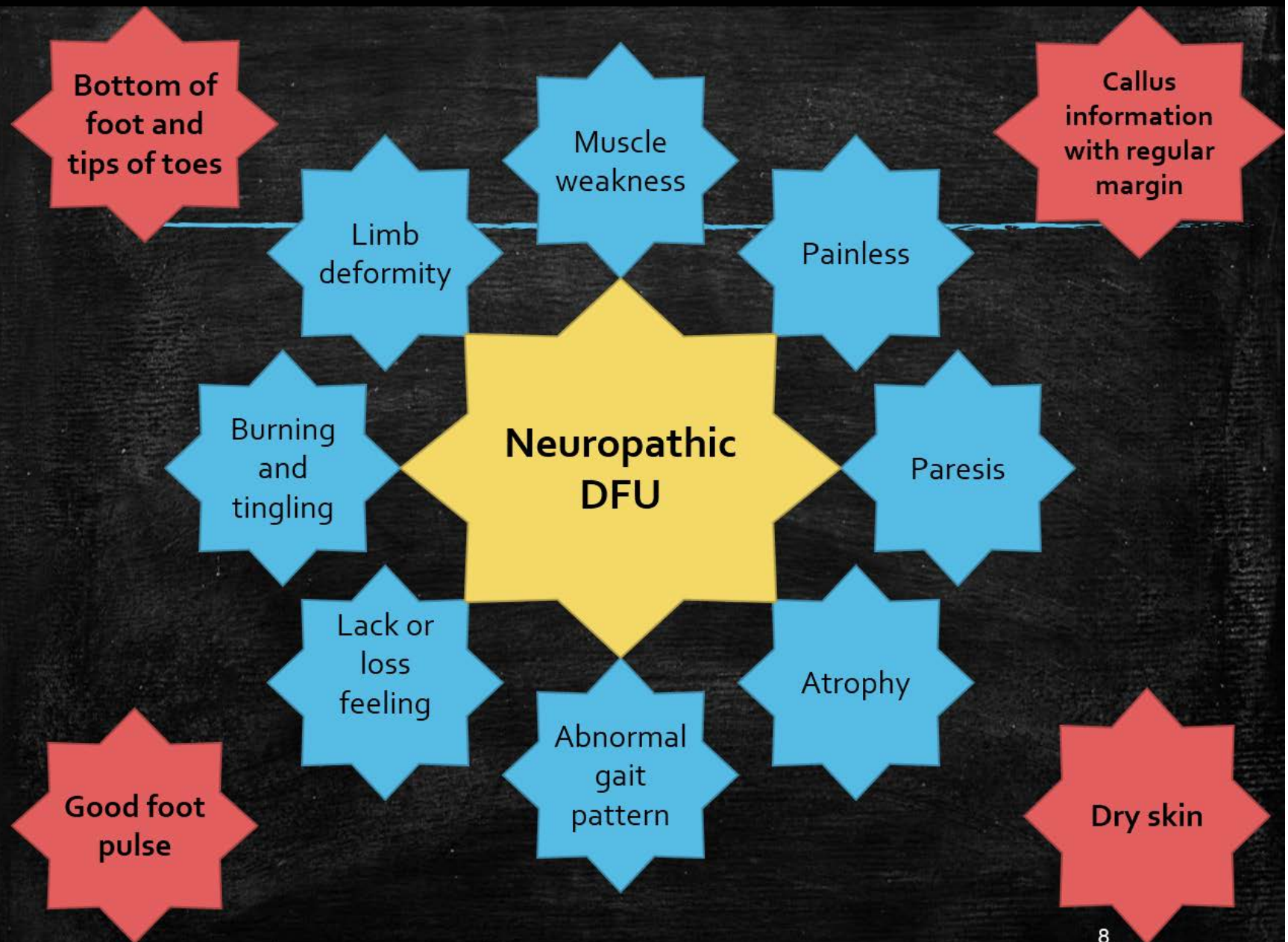
- atrophy or changes in the small muscles of the foot
- Muscle weakness
- Limb deformity (**claw or hammer toes** ,increase the arch of the foot)
- Abnormal gait patterns



Autonomic neuropathy

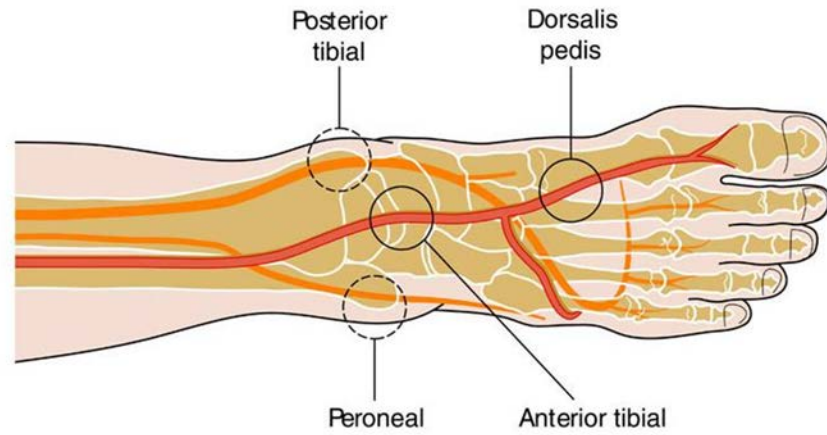
- Heart rate abnormality
- Orthostatic hypotension
- Silent MI
- Impotence
 - Retrograde ejaculation
- Distended veins over the dorsum of the foot and ankle
- Pseudo motor dysfunction
 - Denervation of sweat glands





Ischaemic

TYPES OF DIABETIC FOOT ULCERS



Ischaemic Foot



- The ischaemic foot may be divided into four clinical scenarios:
 1. **Neuroischaemic foot** characterized by both ischaemia and neuropathy and complicated by ulcer
 2. **Critically ischaemic foot**
 3. **Acutely ischaemic foot**
 4. **Renal ischemic foot** characterized by digital necrosis

Neuro-Ischaemic Foot

- The **most frequent presentation** is that of ulceration.
- Ischaemic ulcers are commonly seen **on the margins** of the foot, including the tips of the toes and the areas around the back of the heel.
- They are usually caused by minor trauma or by **wearing unsuitable shoes**.
- Even if **neuropathy** is present because the foot does not develop heavy plantar callus, which requires good blood flow, intermittent claudication and **rest pain** may be absent because of neuropathy and the distal distribution of the arterial disease to the leg.

Critically Ischaemic Foot

- This presents as a **pink**, often **painful** foot with pallor on elevating the foot and rubor on dependency.
- The colour of the critically ischaemic foot can be a deceptively healthy pink or red, caused by dilatation of capillaries in an attempt to improve perfusion



Acutely Ischaemic Foot

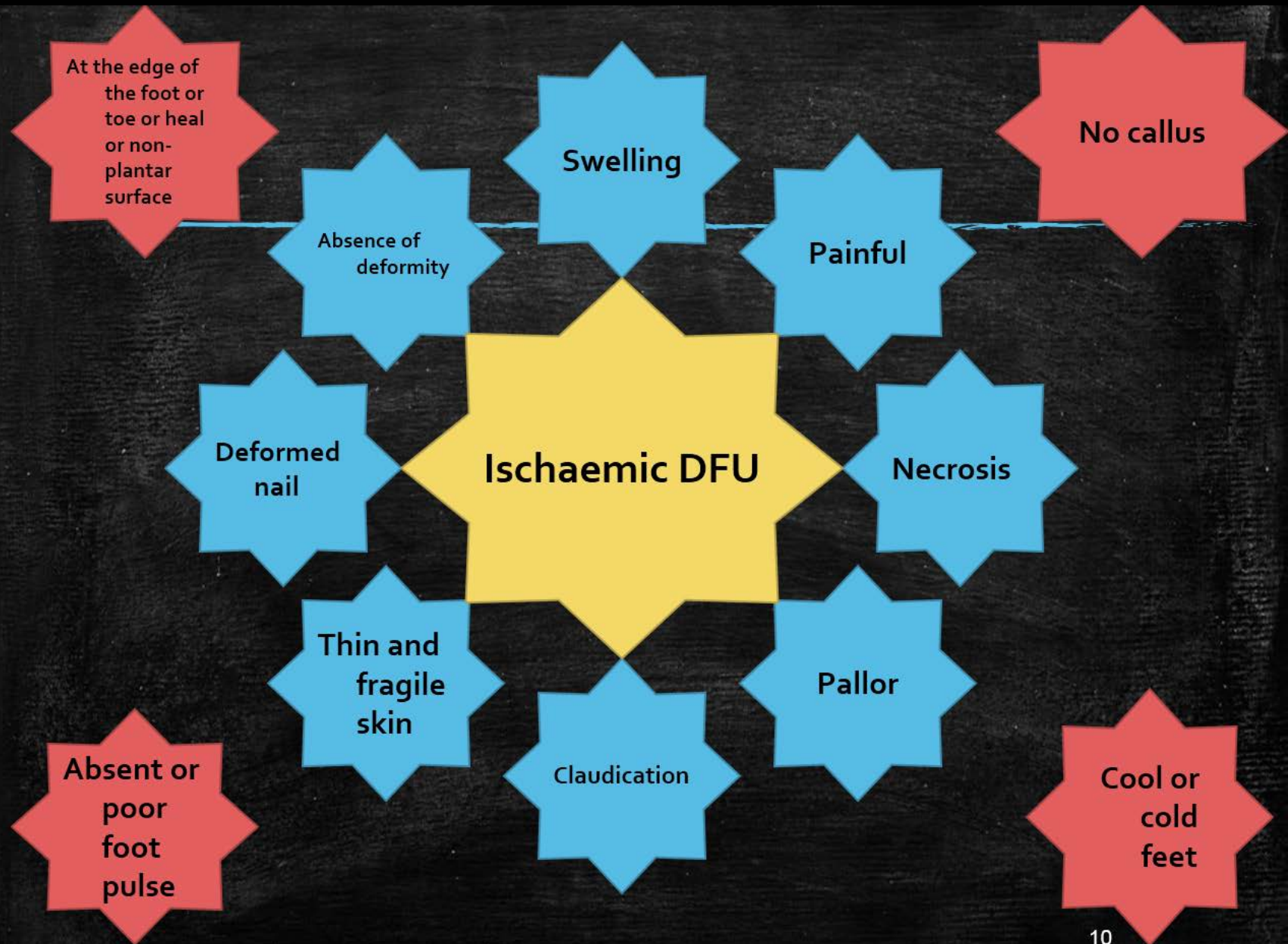
- This presents initially with sudden **pallor** and the foot becomes **mottled**



Renal Ischaemic Foot

- A classical feature of this foot is the **digital necrosis**





Typical features of DFUs according to etiology

Feature	Neuropathic	Ischaemic	Neuroischaemic
Sensation	Sensory loss	Painful	Degree of sensory loss
Callus/necrosis	Callus present and often thick	Necrosis common	Minimal callus Prone to necrosis
Wound bed	Pink and granulating, surrounded by callus	Pale and sloughy with poor granulation	Poor granulation
Foot temperature and pulses	Warm with bounding pulses	Cool with absent pulses	Cool with absent pulses
Other	Dry skin and fissuring	Delayed healing	High risk of infection
Typical location	Weight-bearing areas of the foot, such as metatarsal heads, the heel and over the dorsum of clawed toes	Tips of toes, nail edges and between the toes and lateral borders of the foot	Margins of the foot and toes

Armstrong DG, Cohen K, Courric S, et al. Diabetic foot ulcers and vascular insufficiency. *J Diabetes Sci Technol* 2011; 5(6): 1591-95.

DFU CLASSIFICATIONS

Classification of DFU

- Classification of ulcerations can facilitate a logical to treatment and aid in the **prediction of outcome**.
- Several wound classification systems have been created, based on parameters such as:
 - Extent of infection
 - Neuropathy
 - Ischemia
 - Depth or extent of tissue loss
 - Location

Classification of DFU

- **Wagner ulcer classification system :**
 - The depth of **ulcer penetration**
 - The presence of **osteomyelitis** or gangrene
 - The extent of **tissue necrosis**
- **University of Texas diabetic wound classification system:**
 - The depth of **ulcer penetration**
 - The presence of wound **infection**
 - The presence of clinical sign of lower extremity **ischemia**

Wagner-Meggitt

Diabetic Wound Classification System

Grade	Lesion
0	No open lesion, may have deformity or cellulites
1	Superficial diabetic ulcer (partial or full thickness)
2	Ulcer extension to ligament, tendon, joint capsule, or deep fascia without abscess or osteomyelitis
3	Deep ulcer with abscess, osteomyelitis , or joint sepsis
4	Gangrene localized to option of forefoot or heel
5	Extensive gangrenous involvement of the entire foot

Wagner- G 0



No open lesion, may have deformity or cellulites

Wagner- G 1



Superficial diabetic ulcer (partial or full thickness)

Wagner- G 2



**Ulcer extension to ligament, tendon, joint capsule, or deep fascia
without abscess or osteomyelitis**

Wagner- G 3



Deep ulcer with abscess, osteomyelitis , or joint sepsis

Wagner- G 4



Gangrene localized to option of forefoot or heel

Wagner- G 5

Wagner grade 5



Extensive gangrenous involvement of the entire foot

University Of Texas

Diabetic Wound Classification System

Stages	Description
Stage A	No infection or ischemia
Stage B	Infection present
Stage C	Ischemia present
Stage D	Infection and ischemia present

Grading	Description
Grade 0	Epithelialized wound
Grade 1	Superficial wound
Grade 2	Wound penetrates to tendon or capsules
Grade 3	Wound penetrates to bone or joint

University Of Texas Classification System

	0	1	2	3
A	Pre or postulcerative lesions (Epithelialized)	Superficial, not involving capsule, tendon or bone	PENETRATES TO TENDON OR CAPSULE	PENETRATES TO BONE
B	INFECTION	INFECTION	INFECTION	INFECTION
C	ISCHEMIA	ISCHEMIA	ISCHEMIA	ISCHEMIA
D	INFECTION AND ISCHEMIA	INFECTION AND ISCHEMIA	INFECTION AND ISCHEMIA	INFECTION AND ISCHEMIA

King's Classification

King's Classification

Stages	Lesion
Stage1	Normal foot
Stage2	High risk
Stage3	Ulcerated foot
Stage4	Infected foot
Stage5	Necrotic foot

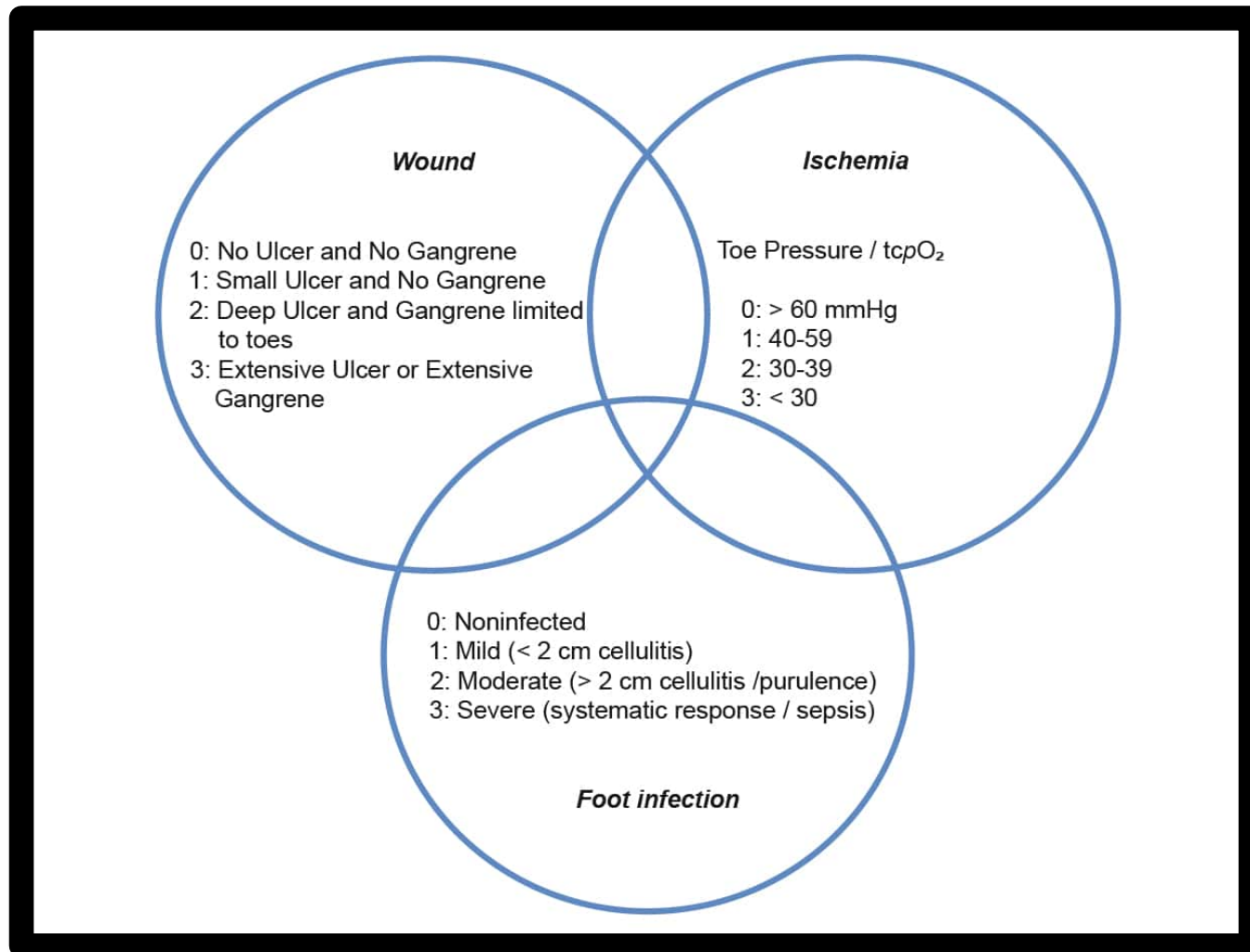
PEDIS Classification

Grade	Perfusion	Extent	Depth	Infection	Sensation	Score
1	No PAD	Skin Intact	Skin Intact	None	No Loss	0
2	PAD, No CLI	<1cm ²	Superficial	Surface	Loss	1
3	CLI	1-3 cm ²	Fascia, Tendon, Muscle	Abscess, Fascitis, Septic Arthritis		2
4		>3 cm ²	Bone or Joint	SIRS		3

Classifications of Diabetic Foot Infection

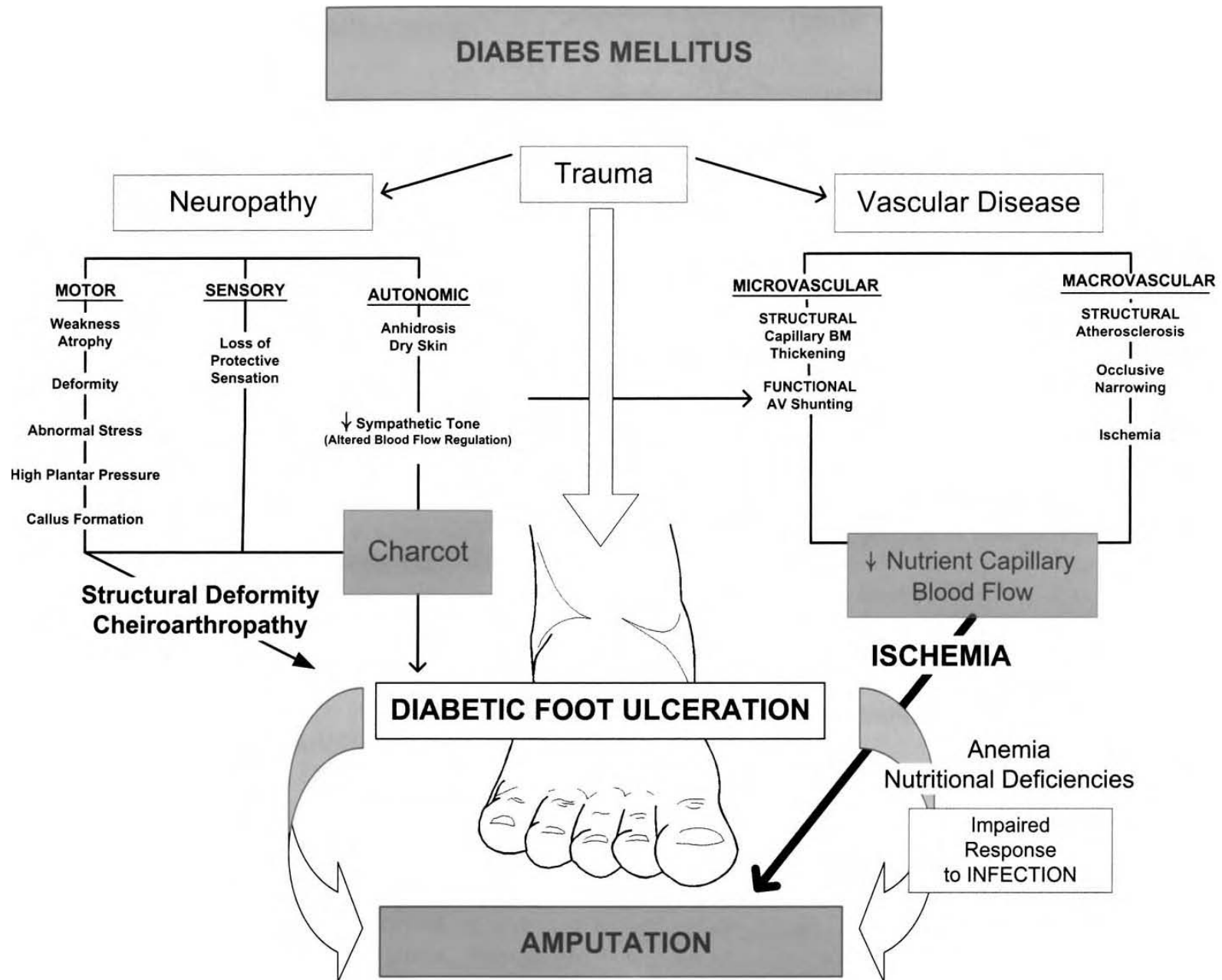
Clinical Manifestation of Infection	PEDIS Grade	IDSA Infection Severity
No symptom or signs of infection	1	Uninfected
Local infection involving only the skin and subcutaneous tissue. If erythema, must be > 0.5 cm to ≤ 2 cm around the ulcer. Exclude other causes of an inflammatory response of the skin: Trauma, Gout, Acute Charcot, Fracture, Thrombosis, Venous stasis	2	Mild
Local infection with erythema > 2 cm, or involving structures deeper than skin and subcutaneous tissues (abscess, osteomyelitis, septic arthritis, fasciitis) and No systemic inflammatory response signs(SIRS)	3	Moderate
Local infection with signs of SIRS, as manifested by ≥ 2 of following : -Temperature $> 38^{\circ}\text{C}$ or $< 36^{\circ}\text{C}$ -Heart rate > 90 beats/min -Respiratory rate > 20 breaths/min or $\text{Paco}_2 < 32$ mmHg -WBC count > 12000 or < 4000 cell/ μl or $\geq 10\%$ immature (band) forms	4	Severe

Wifi Classification



SINBAD Classification

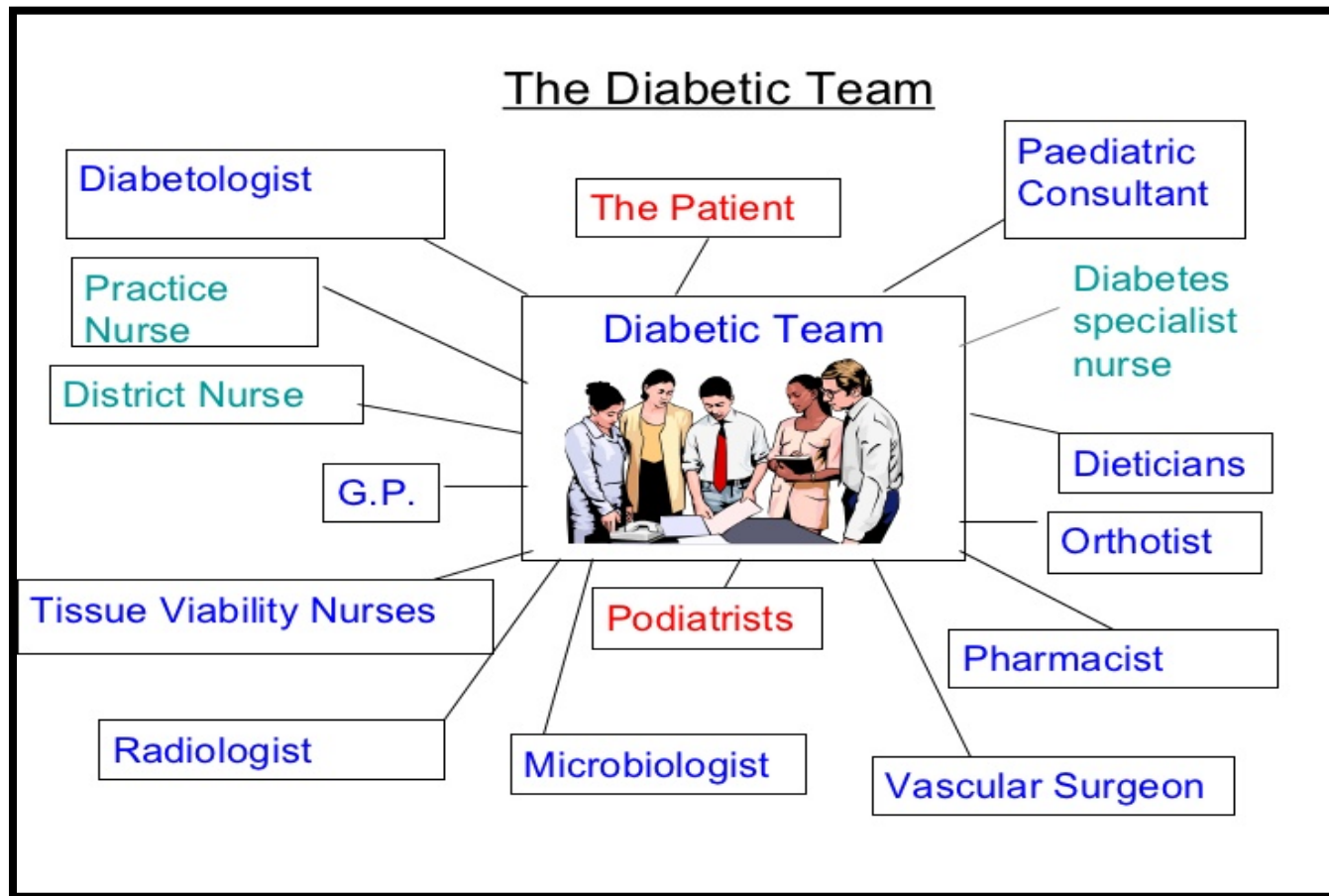
Category	Definition	SINBAD score
Site	•Forefoot	0
	•Midfoot and hindfoot	1
Ischemia	•Pedal blood flow intact, at least one pulse palpable	0
	•Clinical evidence of reduced pedal blood flow	1
Neuropathy	•Protective sensation intact	0
	•Protective sensation lost	1
Bacterial Infection	•None	0
	•Present	1
Area	•Ulcer<1 cm ²	0
	•Ulcer>=1 cm ²	1
Depth	•Ulcer confined to skin and subcutaneous tissue	0
	•Ulcer reaching muscle, tendon or deeper	1

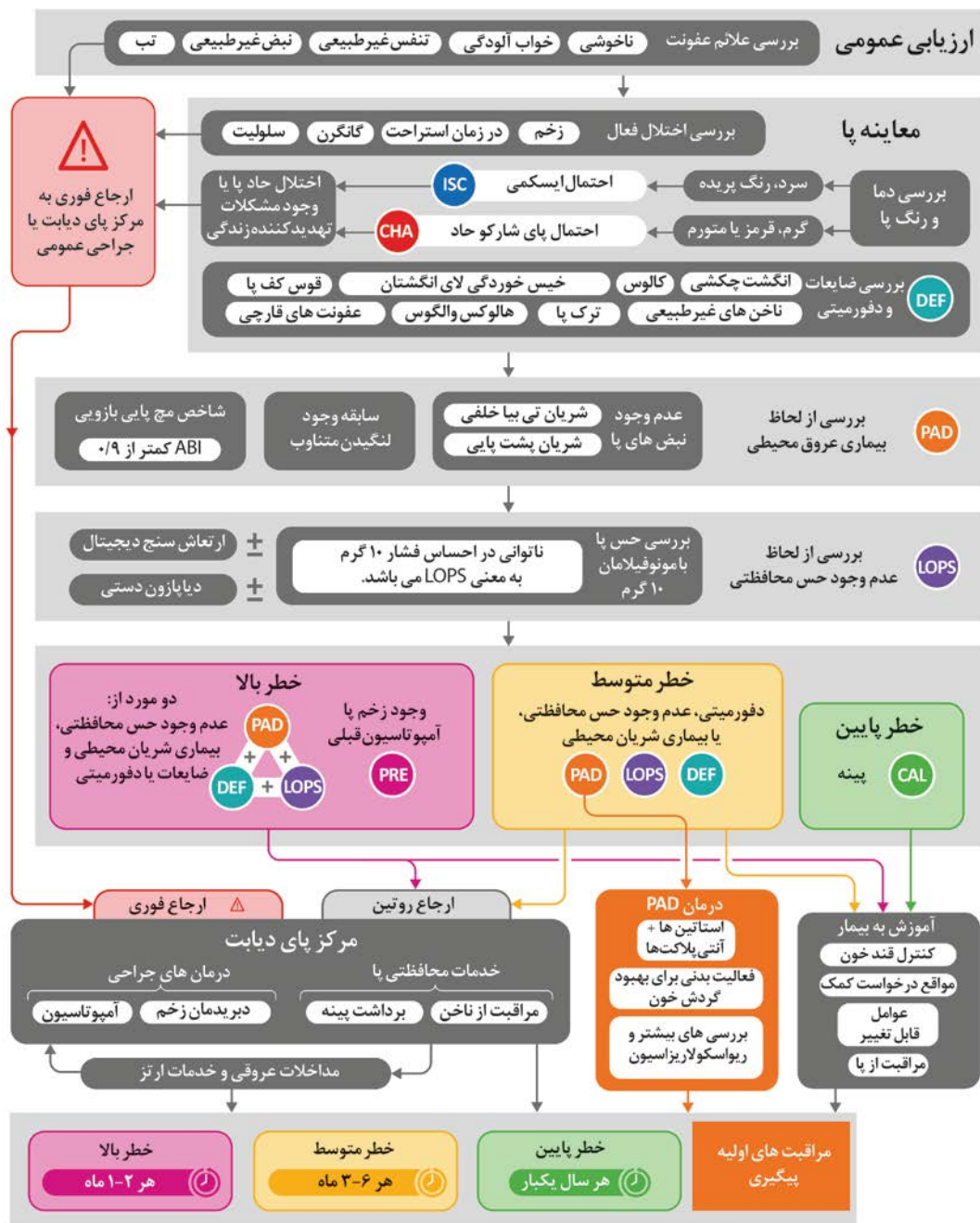


DFUS

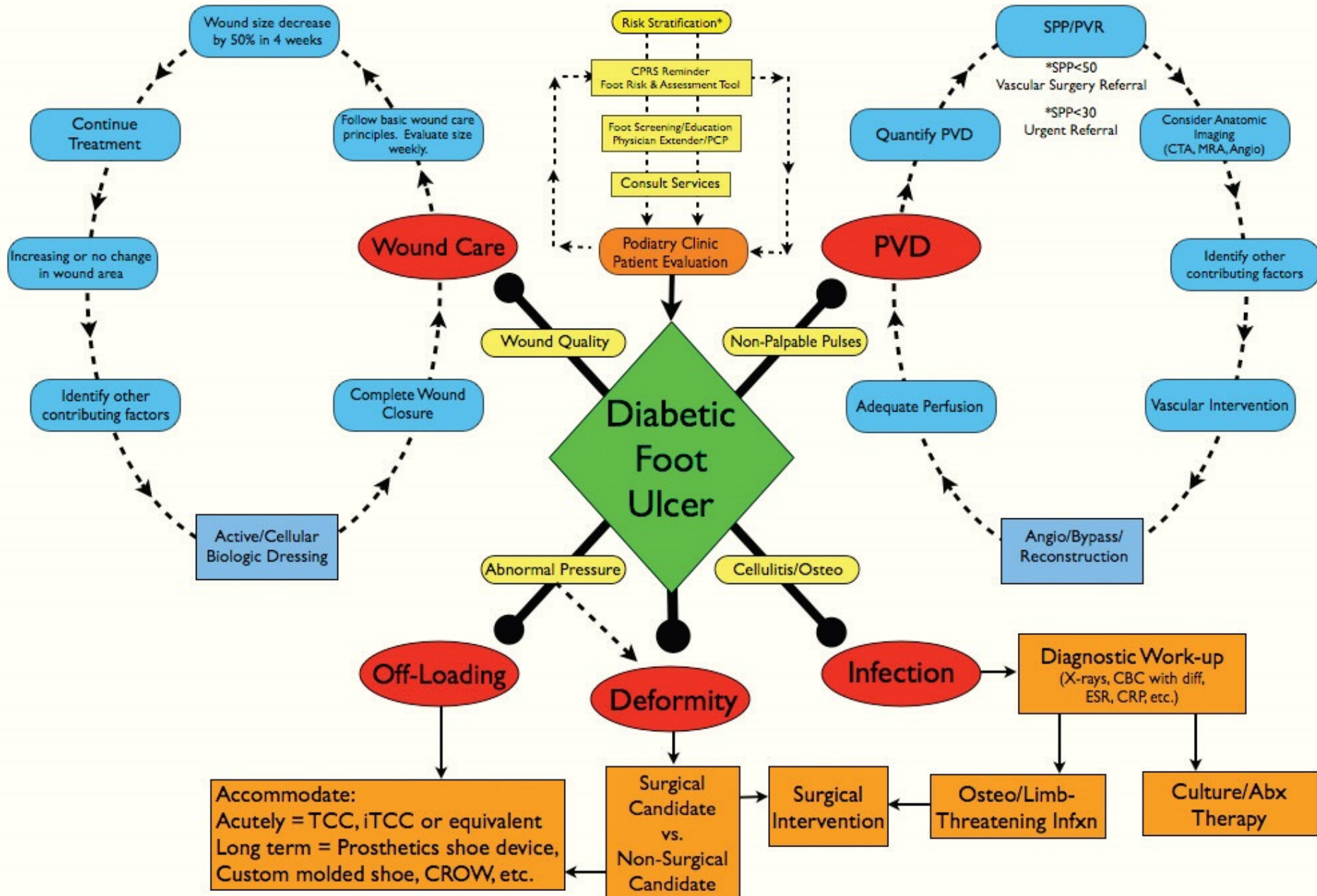
PRINCIPLE & NOVEL OF TREATMENT

Multidisciplinary DF Management





Protocol for Diabetic Foot Ulcer Management



Fast-Track Pathway برای زخم پای دیابتیک



گروپ پای دیابتی
پژوهشگاه علوم غدد و متابولیسم
دانشگاه علوم پزشکی تهران

ارزیابی اولیه

بیماری های همزمان

- نارسایی قلبی
- نارسایی کلیه مرحله آخر
- اسفردگی

رویکرد جامع*

- شرح حال پزشکی
- معاینات بالینی
- پهلوپوزی

* مواظبت بیماران با مشکلات روانی اجتماعی باشد

ارزیابی ضایعات پای دیابتیک و اندام تحتانی

عدم وجود نکروز یا گانگرن
عدم مشاهده استخوان، عضله و یا تاندون
نیض های نرمال
عدم وجود علایم عفونت

زخم پای دیابتیک غیر پیچیده

مراقبت های استاندارد

مشاهده و درمان حداکثر ۲ هفته
نتیجه: ۳۰ درصد کاهش در وسعت زخم
مشاهده گرانولاسیون یا اپیتلیزاسیون مجدد
خبر

پیگیری و ارزیابی مجدد مراقبت های استاندارد

کاهش زمان ترمیم

وجود نکروز
مشاهده استخوان، عضله و یا تاندون
عدم وجود نیض های نرمال
وجود علایم عفونت

زخم پای دیابتیک پیچیده

مراقبت های استاندارد + ارجاع با حداکثر تاخیر ۴ روز

ارجاع به مراکز رفرانس پای دیابت

همکاری با خط اول پیگیری بیشتر

حفظ اندام
بهبود کیفیت زندگی

گانگرن
انتهاز
تب یا سایر علایم سیستمی

زخم پای دیابتیک پیچیده شدید

مراقبت های استاندارد

بستری اورژانسی در کلینیک تخصصی پای دیابت در عرض ۲۴ ساعت

کاهش مورتالیتی
حفظ اندام

اصول مراقبت های استاندارد

کنترل متابولیک / مدیریت جامع: رویکرد متابولیک نیازمند بهینه سازی کنترل گلیسمیک (در صورت نیاز با انسولین)، درمان سوء تغذیه و در صورت وجود ادم می باشد. درمان مطلوب بیمارهای همزمان ضرورت دارد.

مراقبت موضعی زخم: مشاهده و ارزیابی مکرر زخم، دربریدمان و پانسمان باید انجام گیرد. انتخاب پانسمان بر اساس مشخصات زخم همچون بستر زخم، آگزودا، اندازه، عمق و درد موضعی خواهد بود. در مورد زخم های نوروایسکمیک، پانسمان با TLC-NOSF (تکنولوژی کلونید لیپید با فاکتور نانوی الیگوساکارید) باید مورد توجه باشد.

رواسکولاریزاسیون انجام می گیرد. اگر در یک زخم علیرغم درمانهای مطلوب علانیم ترمیم زخم در عرض ۴ هفته مشاهده نگردد (حتی اگر نتایج تستها بیشتر از مقادیر نرمال و قابل قبول باشد) ارزیابی عروقی و رواسکولاریزاسیون مجدد مورد توجه قرار می گیرد.

درمان عفونت: در صورت وجود علایم بالینی عفونت، آنتی بیوتیک تریابی وسیع الطیف بر اساس نتایج نمونه های میکروبیولوژیک (بهرتر است نمونه از بافت عمقی گرفته شود) انجام شده و بر اساس پاسخ بالینی و نتایج آزمایشگاهی ارزیابی بعدی صورت می گیرد. برداشت بافت نکروتیک و ارزیابی جامع شدت عفونت ضروری است.

کاهش فشار: کاهش استرس بیومکانیکال داخلی یا خارجی و فشار کف پای برای حفاظت و ترمیم زخم ضرورت دارد. استفاده از تجهیزات کاهنده فشار غیر قابل برداشتن تا سر زانو، قالبهای تمام تماسی و اگرهای قابل برداشتن با پوشش پای تخصصی بسته به نیاز بیمار و بر اساس منابع در دسترس محلی مورد استفاده قرار می گیرد. به بیماران آموزش داده می شود تا مدت نشستن و ایستادن خود را کاهش دهند. جهت اطمینان از اثربخشی بالینی و پذیرش بیمار پیگیری منظم انجام می شود.

برقراری پرفوژیون پا: در بیماران دچار بیماری شریانی محیطی (فشار میج پای کمتر از ۵۰ mmHg، فشار شست پا کمتر از ۳۰ mmHg، یا TcPO2 کمتر از ۲۵ mmHg)

زخم پای دیابتیک

مراقبت‌های موضعی استاندارد

کاهش فشار

کاهش فشار جهت حفاظت و ترمیم زخم ضروری است.
اگر توان کاهش فشار در پای بیمار را نداشتید در برگ گزارش بیمار نوشته یا به بیمار اطلاع دهید.

توصیه

- در زخم پای دیابتیک که عفونی یا ایسکمیک بوده یا در ناحیه خلف پا باشد بر اساس شغل یا ارزیابی احتمال افتادن بیمار مناسب‌ترین وسیله کاهش فشار را برای بیمار انتخاب کنید.
- در زخم پای دیابتیک که عفونی یا ایسکمیک نبوده و در ناحیه میانی یا قدام پا باشد وسیله کاهش فشار غیر قابل برداشتن و در صورت در دسترس نبودن وسیله کاهش فشار قابل برداشتن را انتخاب نمایید.

دبریدمان

در تمامی زخم‌های پای دیابتیک بافت نکروز، بقایای سطحی و کالوس اطراف زخم دبرید می‌گردد.
این کار ارزیابی صحیح زخم را تسهیل نموده و با کمک به گرانولاسیون ترمیم زخم را سرعت می‌بخشد.

توصیه

- در زخم پای دیابتیک ایسکمیک دبریدمان مکانیکال مناسب می‌باشد. با این وجود دبریدمان شارپ یا اتولیتیک نیز می‌تواند انجام شود.
- در زخم پای دیابتیک غیر ایسکمیک تمامی انواع دبریدمان قابل انجام می‌باشد.

ارزیابی زخم

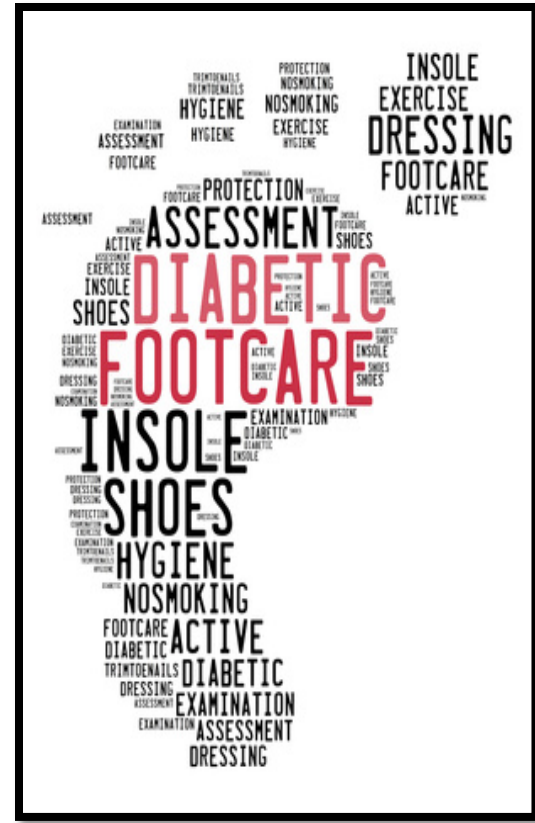
مشاهده و ارزیابی مکرر زخم پای دیابتیک و پانسمان زخم بر اساس مشخصات زخم انجام می‌شود.
ارزیابی بستر و حاشیه زخم را بر اساس ابزار ارزیابی محلی انجام دهید. با بسترسازی مناسب زخم بهترین مراقبت را می‌توان انجام داد.

زخم غیر عفونی

زخم عفونی

Modern management of the diabetic foot

- 1. Assessment**
- 2. Classification**
- 3. Staging**
- 4. Intervention**



Assessment

1. Neuropathy
2. Ischaemia
3. Deformity
4. Callus
5. Edema
6. Skin Disorders
7. Infection
8. Necrosis



Classification



Staging

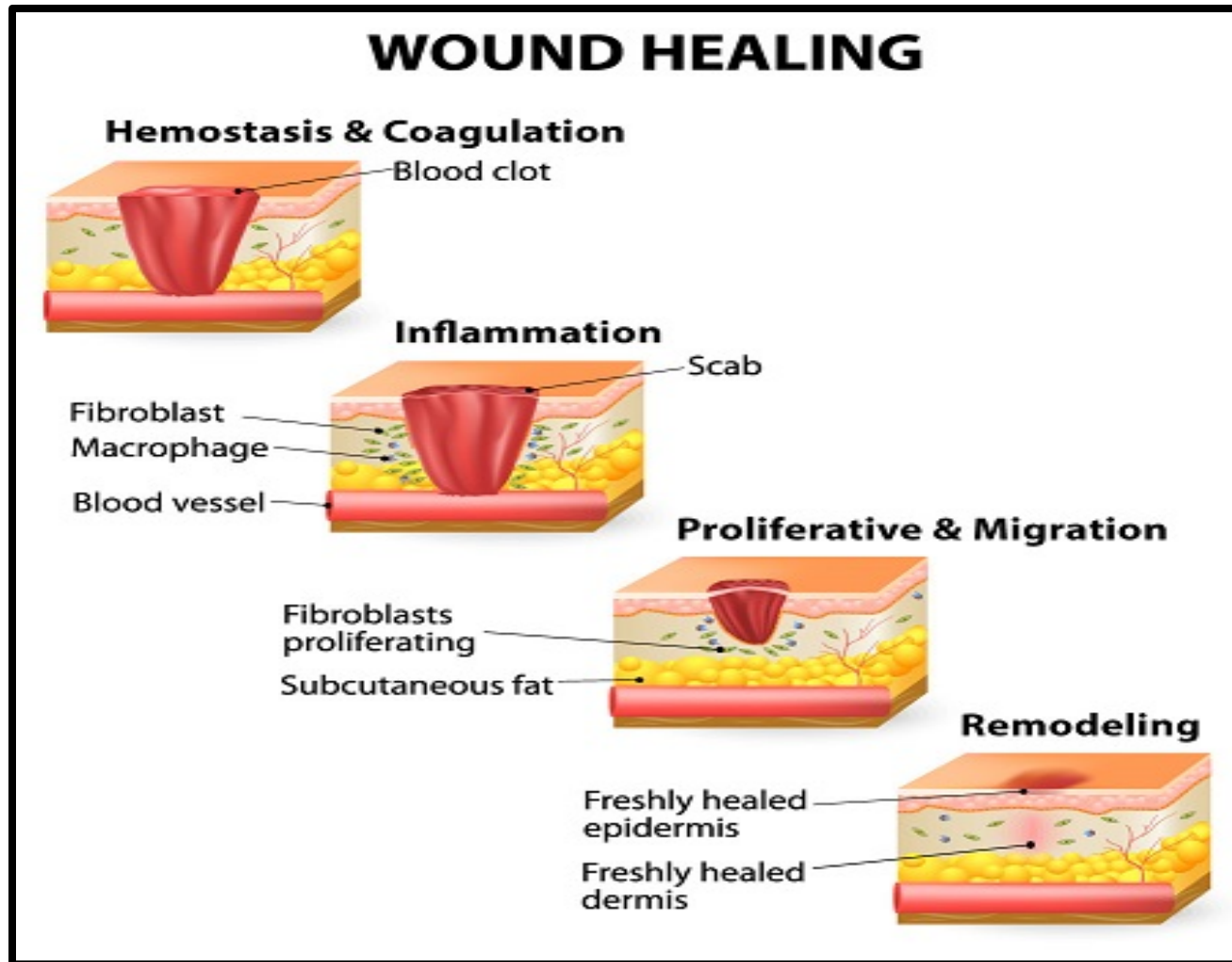
Stage 1:	Normal foot
Stage 2:	High-risk foot
Stage 3:	Ulcerated foot
Stage 4:	Infected foot
Stage 5:	Necrotic foot
Stage 6:	Unsalvageable foot

Intervention

1. Wound Control
2. Microbial Control
3. Mechanical Control
4. Vascular Control
5. Metabolic Control
6. Educational Control



Wound Healing Process



Factors affecting on wound healing

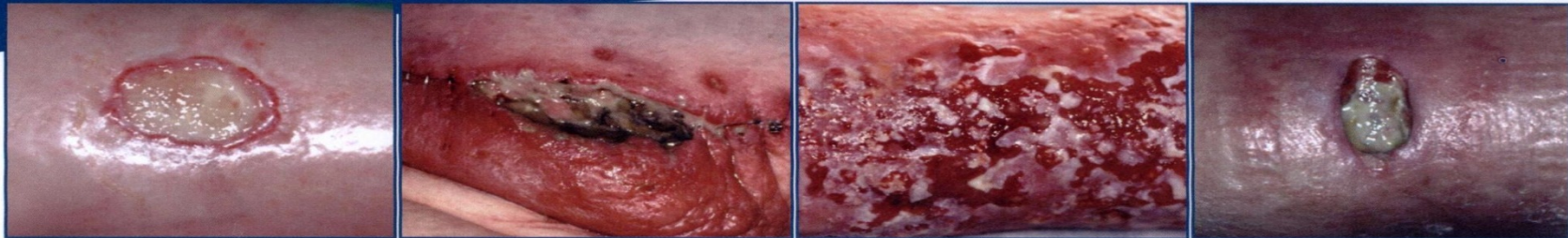
Local

- Necrotic tissue
- Infection/ Biofilm
- Exudate
- MMPs
- Growth factors
- Tissue hypoxia
- Repeated trauma
- Edema
- Irradiation

• Local

- Diabetes
- Age
- Malnutrition
- Immunodeficiency
- Obesity
- Smoking
- Anemia
- Immunosuppressive therapy

T.I.M.E



T
TISSUE

I
INFECTION OR
INFLAMMATION

M
MOISTURE
IMBALANCE

E
EDGE OF WOUND
NOT ADVANCING

Non-viable
necrotic
tissue or slough
present

Increased exudate,
surface discoloration
increased

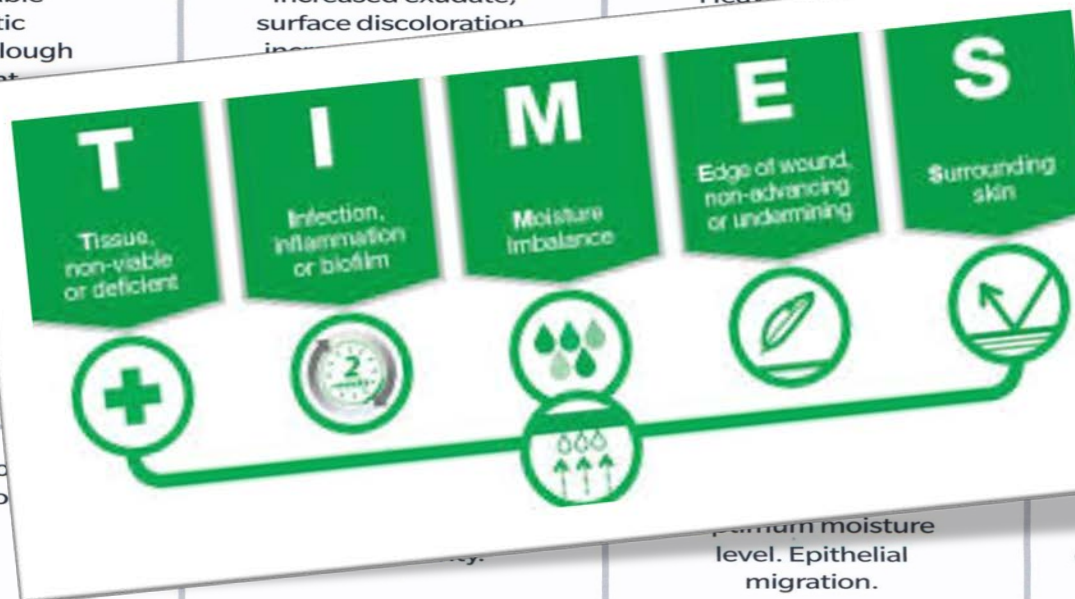
Heavy exudate

Non-advancing or
undermining wound
with prolonged
inflammation.

Assessment
debridement
viable tissue
foreign material

Autolytic, Medical
Surgical, Enzymatic
Biological

Viable wound
bed restoration



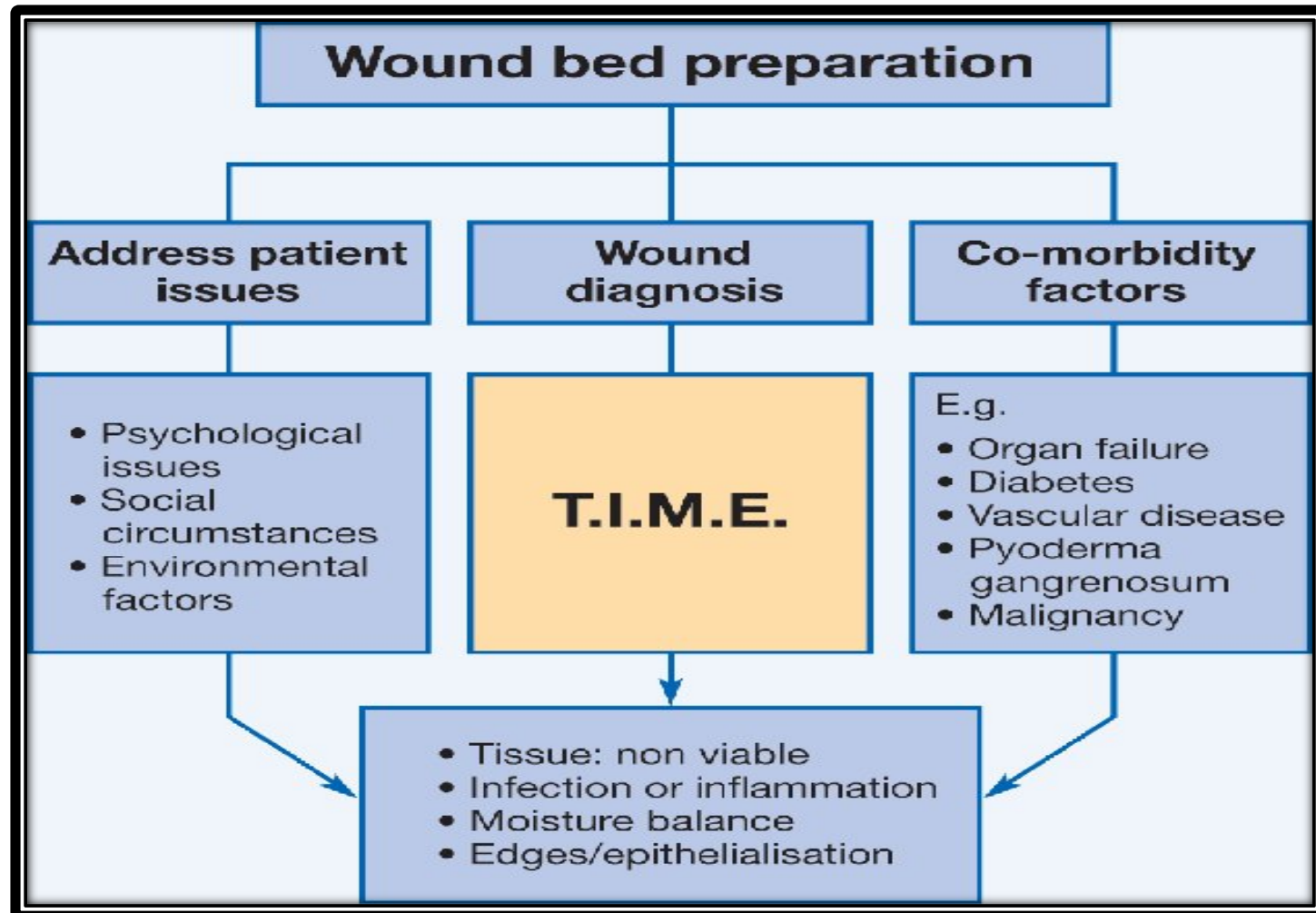
Assessment of non-
advancing wound edges.

Consider further
debridement. Consider
other therapies.

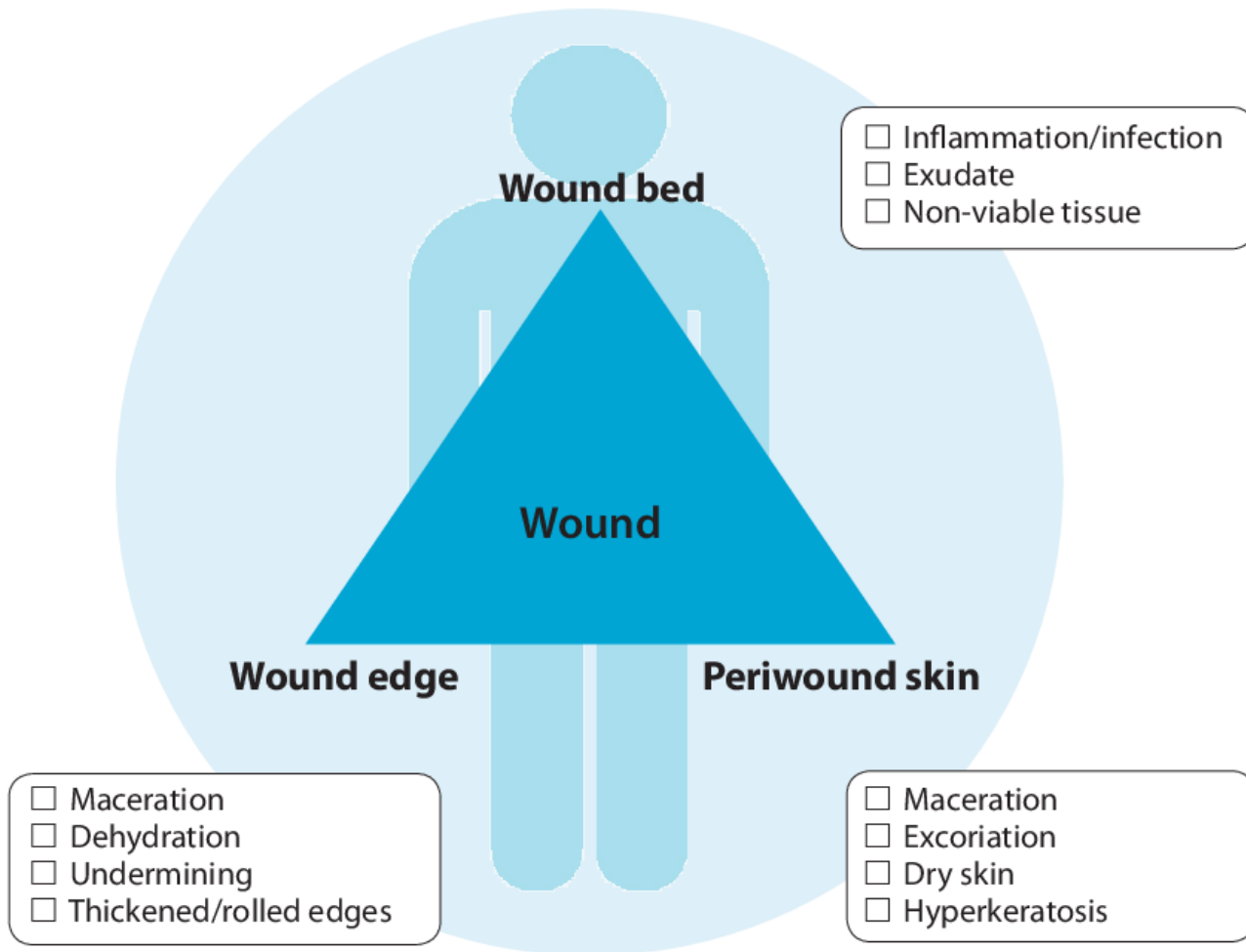
Restoration of
bacterial and moisture
balance to encourage
epithelial advancement.

maintain moisture
level. Epithelial
migration.

Wound bed preparation



Triangle Wound Assessment



Wound Control

Debridement

- **Definition:**

Debridement is the process of removing nonliving tissue from pressure ulcers, **burns**, and other **wounds**.

- **Types:**

- Autolytic
- Mechanical
- Biological
- Ultrasonic
- Hydrosurgical
- Sharp
- Surgical



Principal of Debridement: The Diabetic Foot, June 2004

Targets of debridement

- **Remove**

- Necrosis
- Slough
- Callus
- Sources infection
- Exudate
- Pus
- Foreign bodies
- Haematomas

- **Decrease**

- Odour
- Excess moisture
- Risk of infection

- **Stimulate**

- Wound edges
- Epithelialisation

- **Improve**

- Quality of life



(Wounds UK, 2013; Strohal et al, 2013).



FIGURE 10: Neuroischaemic ulcer pre- (top) and post- (bottom) debridement



FIGURE 9: Neuropathic ulcer pre- (top) and post- (bottom) debridement

Wound Control

Dressing

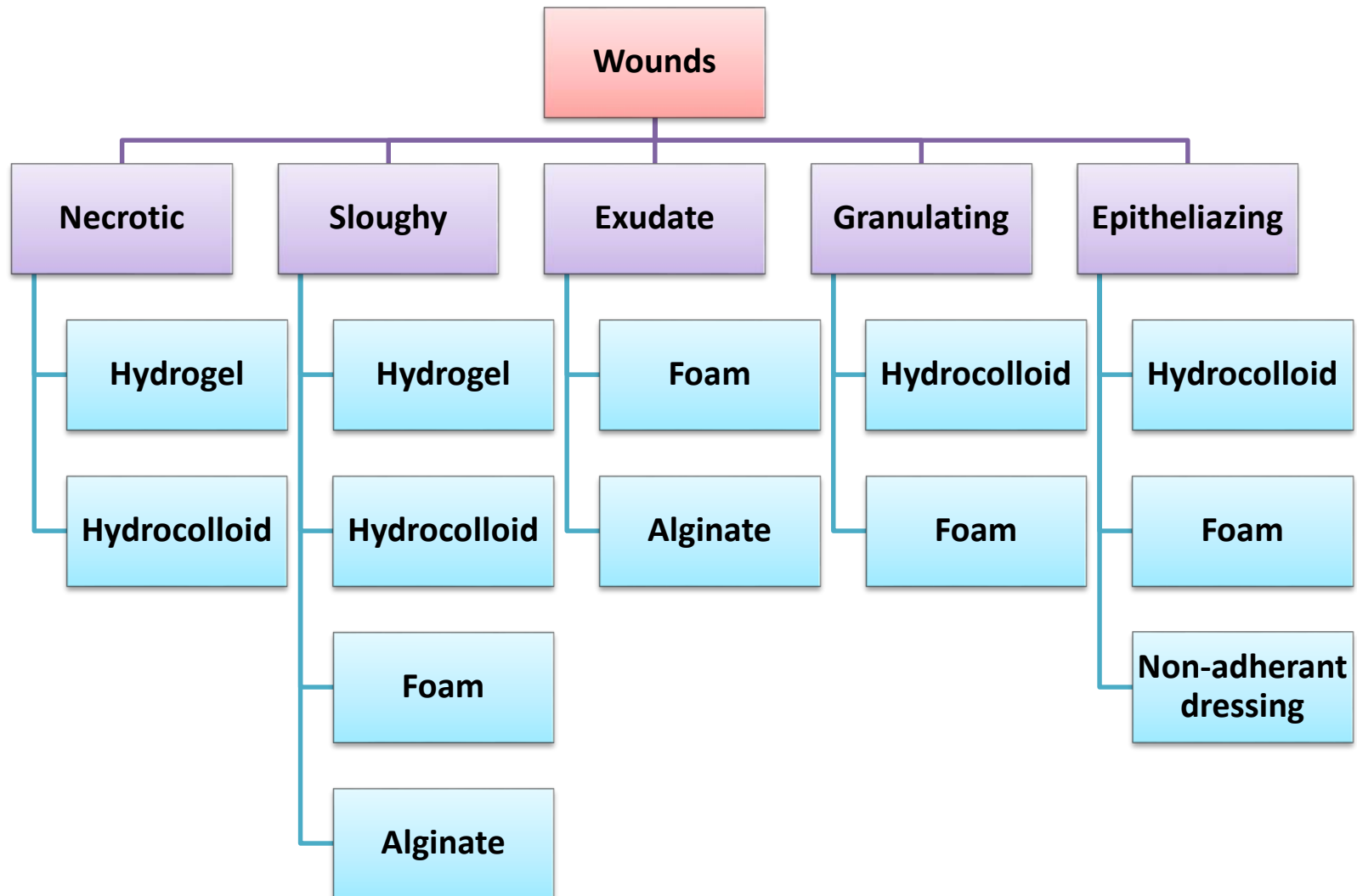
- To decrease purulent wound drainage
- To promote wound granulation and healing
- To prevent undue contamination of wound
- To assist the homeostasis and prevention of bleeding
- To keep the open wound warm
- The **main objective of dressing** include: **moisture regulation and facilitate of epithelial tissue**



Categories of Wound Dressings

- Absorbent Dressings: Alginate, Foam, Hydrofiber
- Moisture keeping Dressings: Film, Hydrocolloid
- Moisture Released Dressings: Hydrogel
- Antimicrobial Dressings: Silver, Iodine dressing

Dressing



Microbial Control

Around 50% of DFUs become infected, and in approximately 20% of these patients, infection will lead to amputation (Wu et al, 2007).

The classic signs of infection should be assessed for, such as:

- Redness
- Heat
- Pain
- Swelling.

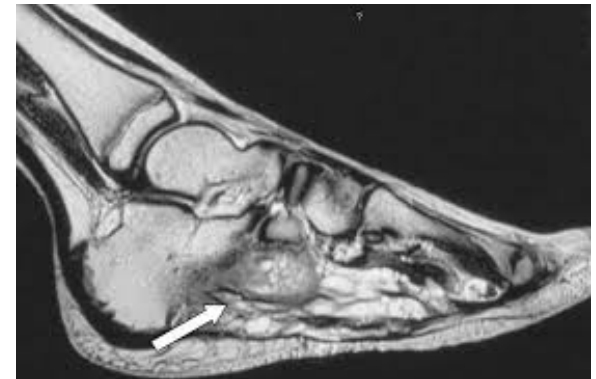
- Exudate
- Malodour
- Wound undermining
- Friable granulation tissue.



Microbial Evaluation

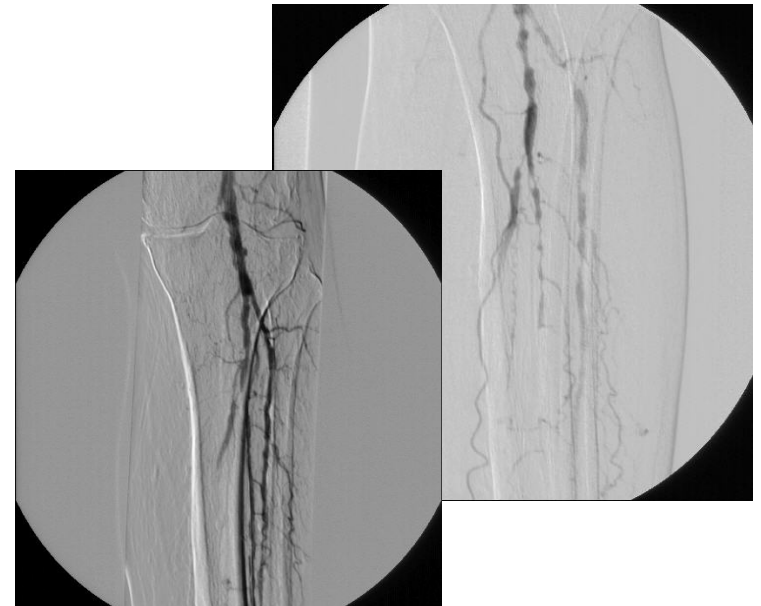
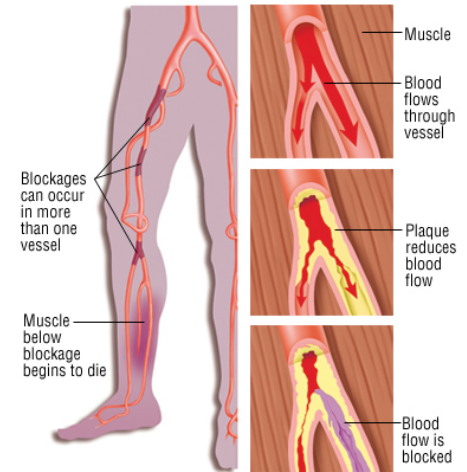
• **Plain radiograph** of the right foot of last patient Osteomyelitis of the fifth metatarsal head and the proximal phalanx of the fifth toe, **subluxation of the metatarsophalangeal joint, calcification of the digital artery** between the first two metatarsals and osteoarthritis of the first distal phalangophalangeal joint of the hallux .

• **Diabetic Foot MRI**



Vascular Control

- Studies reported herein appear to demonstrate improved rates of limb salvage associated with revascularization compared with the results of non-revascularized patients with diabetes, PAD and ulceration



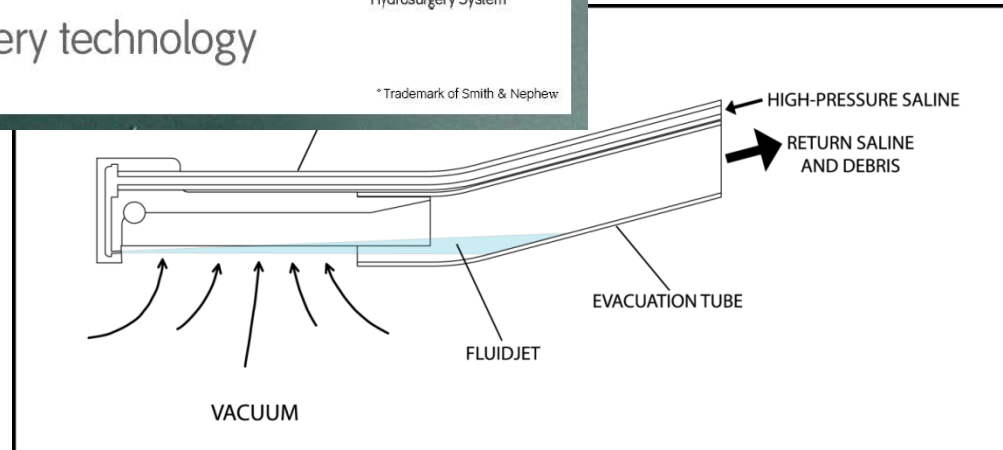
Mechanical Control

- Offloading is required you to keep all weight off of the extremity that has the ulcer.
- Casting and prefabricated healing devices
- Therapeutic footwear



NOVEL TREATMENTS

Advanced Hydrosurgery Technology

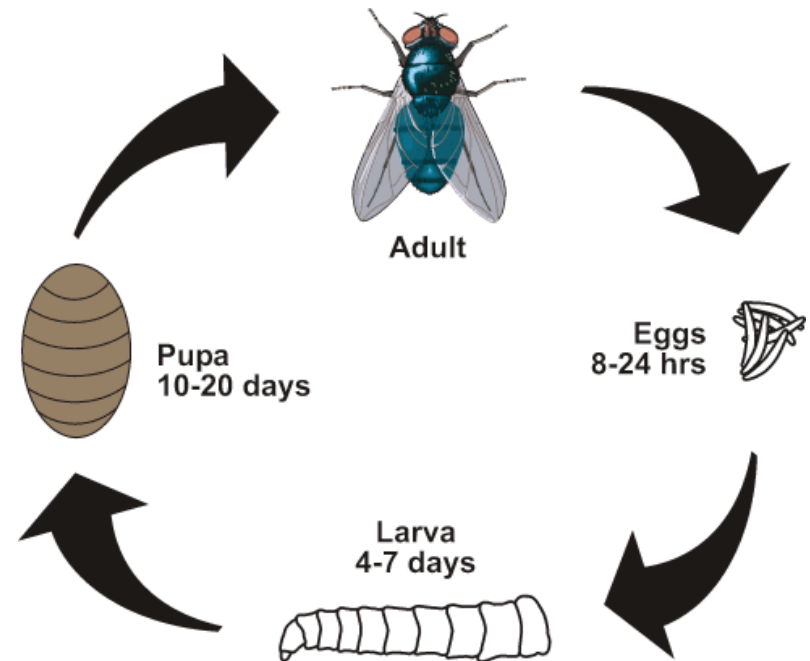


Sonography assisted Debridement Soring



Maggot Therapy

- **Maggot therapy (maggot debridement therapy (MDT))** is a type of biotherapy involving the introduction of live, disinfected maggots (fly larvae) into the non-healing skin and soft tissue wound(s) of a human or animal for the purpose of cleaning out the necrotic (dead) tissue within a wound (debridement) and disinfection.
- **Diversity of wound types**
- **Remove necrotic flesh**
- **Antimicrobial properties (MRSA)**
- **Promote Wound Healing**



HYDROMECHANICAL DEBRIDEMENT SYSTEM

- Advanced Wound Irrigation
- Safely Debride a Wide Variety of Wounds
- **Indications:**
 - Chronic and acute wounds
 - Partial- and full-thickness wounds
 - Pressure injuries I-IV
 - Venous stasis ulcers
 - Arterial ulcers
 - Diabetic ulcers
 - Traumatic wounds
 - First- and second-degree burns
- **Contraindications:**
 - Gangrene
 - Deep soft tissue infection – untreated necrotizing fasciitis
 - Exposed soft organ tissues
 - Exposed vascular structures, grafts or hardware
 - Untreated malignancy



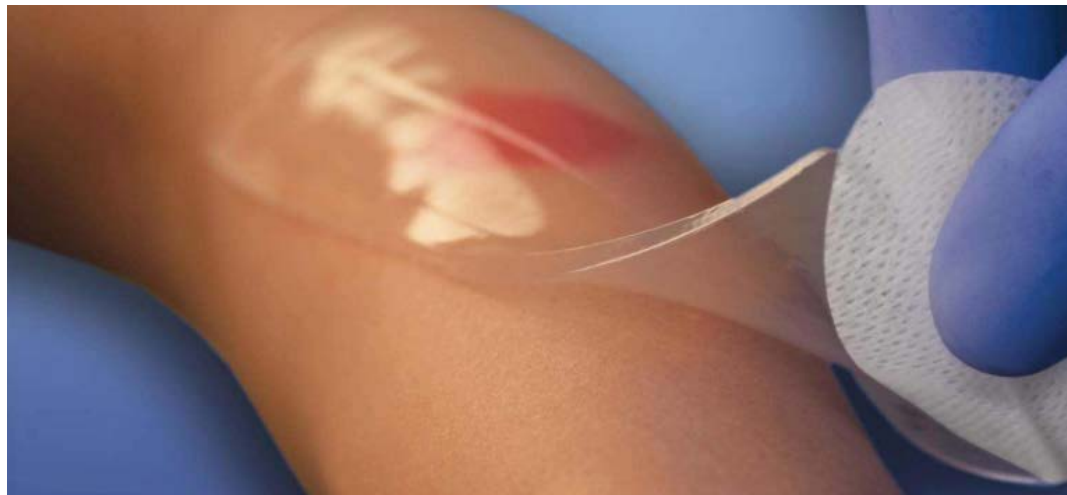
Negative-pressure wound therapy

- **Negative-pressure wound therapy (NPWT)** is a therapeutic technique using a vacuum dressing to promote healing in acute or chronic wounds and enhance healing of second and third degree burns.
- The therapy involves the controlled application of sub-atmospheric pressure to the local wound environment, using a sealed wound dressing connected to a vacuum pump.
- NPWT appears to be useful for **diabetic ulcers** and management of the open abdomen (laparotomy) .



Xie, X.; McGregor, M.; Dendukuri, N. (November 2010). "The clinical effectiveness of negative pressure wound therapy: a systematic review". *Journal of Wound Care*. **19**(11): 490–5.

Hydrogel dressing



Biocellular Membrane Dressing



Ozone Therapy

- Oxidative stress is suggested to have an important role in the development of complications in diabetes.
- Because ozone therapy can activate the antioxidant system, influencing the level of glycemia and some markers of endothelial cell damage.



Therapeutic efficacy of ozone in patients with diabetic foot
Gregorio Martínez-Sánchez and etc., European Journal of Pharmacology
Volume 523, Issues 1–3, 31 October 2005, Pages 151–161

Carbon Dioxide Therapy



Hyperbaric Oxygen Therapy (HBOT)

- Hyperbaric oxygen therapy (HBOT) is breathing 100% oxygen while under increased atmospheric pressure.
- The experimentally demonstrated effects of HBOT on improving wound tissue hypoxia, enhancing perfusion, reducing edema, down regulating inflammatory cytokines, promoting fibroblast proliferation, collagen production, and angiogenesis make it a useful adjunct in clinical practice for “problem wounds,” such as diabetic foot ulcers .
- HBOT is also touted for eradicating difficult to treat soft tissue and bone infections by mechanisms that include killing microorganisms, improving leukocyte and macrophage function, and enhancing the effect of antimicrobials.



Hyperbaric Oxygen Therapy for Diabetic Foot Wounds
Benjamin A. Lipsky, Diabetes Care 2010

May; 33(5): 1143-1145.

Laser therapy

- The wounds in subjects treated with LLLT contracted significantly more than the wounds in the non-treated group which indicates that LLLT is an effective modality to facilitate wound contraction in patients suffering from diabetes and can be used as an adjunct to conventional mode of treatment (dressings and debridement) for healing of diabetic wounds.
- The clinical efficacy of LLLT in wound healing has been reported.
- It has been found to significantly decrease the time of wound healing .



Shockwave Therapy

Shockwave for Diabetic foot Ulcers



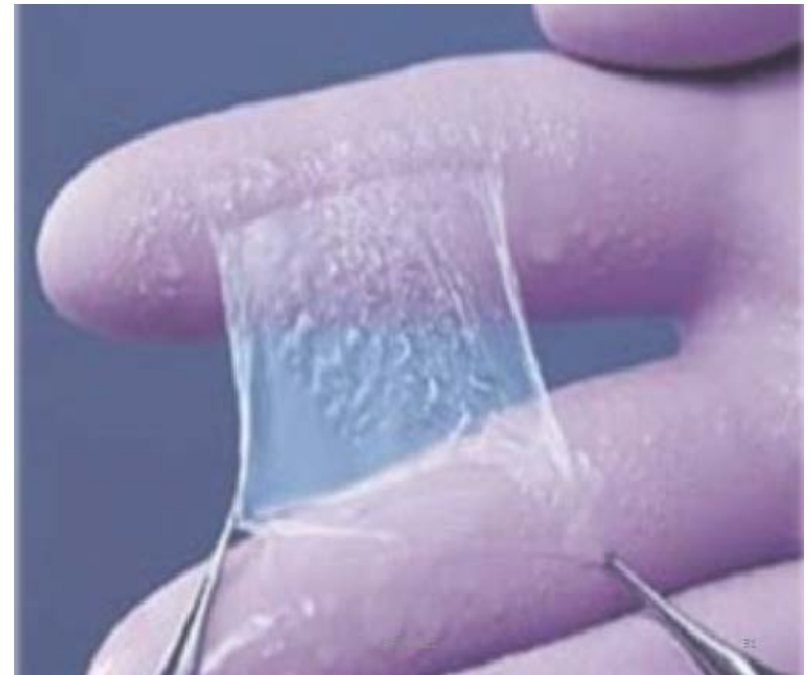
Plasma Medicine

- ☐ Hospital hygiene
- ☐ Antifungal treatment
- ☐ Dental care
- ☐ Skin disease
- ☒ **Chronic wound**
- ☐ Cosmetic
- ☐ Blood coagulation
- ☐ Pharmaceutical process
- ☐ Cancer treatment
- ☐ Improvement of proliferation of human cells
- ☐ Triggering of apoptosis on cells
- ☐ Painless
- ☐ Safe
- ☐ No Contact
- ☐ No Complications
- ☐ Non-destructive to tissue
- ☐ Effective in inactivation of various parasites and foreign organisms
- ☐ High bactericidal effectiveness
- ☐ Easy access into narrow and confined spaces



Bioimplant

- The bioimplant dressing was significantly superior to the wet dressing in prompting the complete healing of DFUs.
- Ease of use, absence of adverse effects, and a facilitated wound healing process are among properties of **amniotic membrane** that make it an appropriate dressing in the management of DFUs.



Extracellular Matrix

- It is indicated to treat the following types of chronic and acute wounds:
 - Abrasions
 - Burns (second-degree only),
 - Chronic vascular ulcers
 - Diabetic ulcers
 - Donor sites
 - Lacerations
 - Pressure ulcers
 - Post-surgical dermal wounds
 - Skin tears
 - Venous ulcers



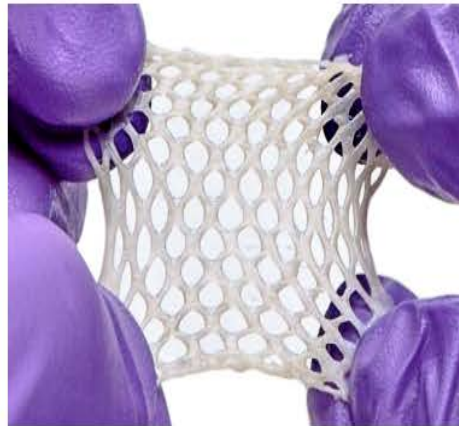
Skin Graft

- Split-skin grafting is an effective method of managing diabetic foot ulcers as, compared with the conservative dressings , it reduced healing times and the length of hospital stay, while donor-site morbidity was minimal.
- Two artificial skin materials are commercial available, **Apligraf** and **Dermagraft**.



Split-skin graft in the management of diabetic foot ulcers.
[J Wound Care](#). 2008 Jul;17(7):303-6.

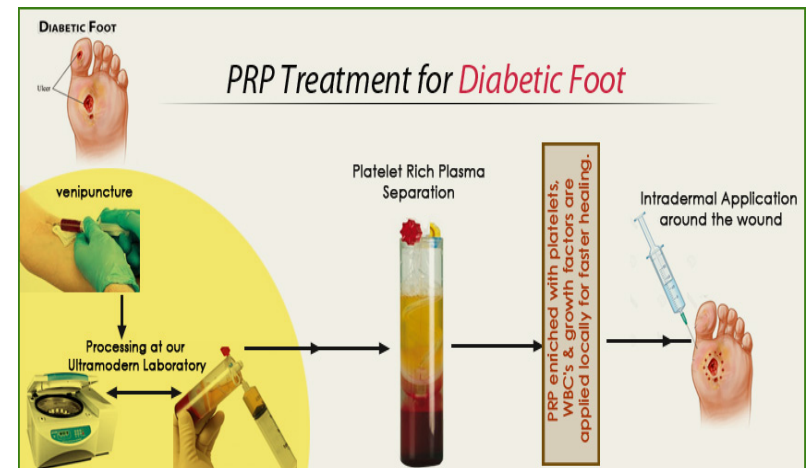
Dermacell



Dermacell AWM®
Advanced Wound Management

Platelet-Rich Plasma

- Platelet-rich plasma is an autologous source of platelet-derived growth factor and transforming growth factor beta that is obtained by sequestering and concentrating platelets by gradient density centrifugation.
- The use of autologous platelet-rich plasma (PRP), which is rich in multiple growth factors, may bear some similarities to the natural wound healing process.



Treatment of a Non-Healing Diabetic Foot Ulcer With Platelet-Rich Plasma, Deepak H Suresh and etc,
[J Cutan Aesthet Surg](#). 2014 Oct-Dec; 7(4): 229–231.

Stem Cell Therapy

- Stem cells are a promising treatment for DFUs as they are capable of targeting, as well as bypassing, the underlying abnormal healing mechanisms and deranged cell signaling in diabetic wounds and promote healing.



The role of stem cells in the treatment of diabetic foot ulcers.
[Diabetes Res Clin Pract.](#) 2012 Apr;96(1):1-9.

Antioxidant wound dressing

Reoxcare

MAXIMIZING THE NATURAL WOUND HEALING PROCESS

ANTIOXIDANT INNOVATION FOR
NATURAL WOUND HEALING



Locust bean
gum



Absorbent
matrix



Curcumin +
acetylcysteine



Antioxidant
solution

ANGIPARSTM

- ✓ **No side effects**
- ✓ More effective than standard therapy
- ✓ Can be used in *all types of diabetic ulcers*
- ✓ Decreased **mean duration** of hospital stay
- ✓ Decreased direct and indirect **costs**
- ✓ Beneficial effects **even after discontinuation**
- ✓ Decreased **amputation rate**



Thank You



گروه تحقیقاتی پای دیابتی

مرکز تحقیقات دیابت
پژوهشگاه علوم غدد و متابولیسم
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