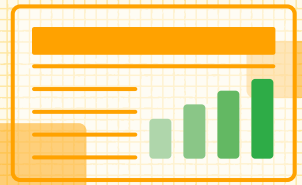


# Diabetes care: begins with a single step

Diabetes-related Foot Disease Health Education Handbook



# OUTLINE



## To know about diabetic foot ulcers (DFU)

What is DFU ? .....	p1.
Three major causes of DFU .....	p2.
What symptoms should I be aware of ? .....	p4.
Who are the at-risk groups of DFU? (Self-check list) ----	p5.
The impact of ulcer wounds on daily life .....	p6.

## The impact of poor DFU control

Common complications .....	p7.
Infection: When the disease enters from wounds .....	p8.
Gangrene: Ischemic tissue necrosis .....	p10.
Amputation: Remove bone or joint .....	p11.
Early detection and treatment to prevent recurrence --	p13.

## Five main treatments of DFU

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Medication and adjunctive therapy .....	p19.
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## Self-care

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Healthy lifestyle .....	p24.

References .....	p25.
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# What is a diabetic foot ulcer ? (DFU)

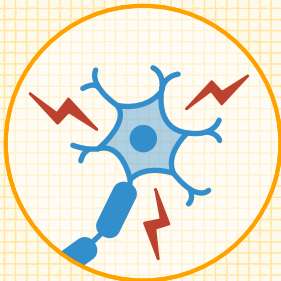
Long hyperglycemia status in diabetic patients may **damage peripheral nerves and blood vessels**. If **uneven pressure on the feet** leads to calluses or trauma, it may further result in wounds that are **difficult to heal and damage to the skin and tissues**, known as

→ **diabetic foot ulcers !**

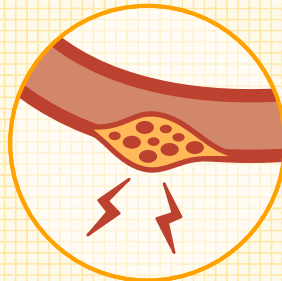


DFU is one of the major causes of amputation and death in patients. All patients are recommended to check their foot conditions regularly.

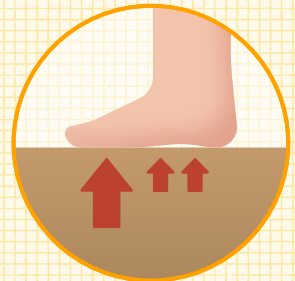
## Three major causes of DFU



**Neuropathy**



**Peripheral  
Vascular Disease**



**Uneven  
Foot Stress**

# Three major causes of DFU

## No.1 : Neuropathy

Nearly 80% of patients with diabetic foot ulcers develop neuropathy and may impact three nervous systems :

### Peripheral sensory neuropathy

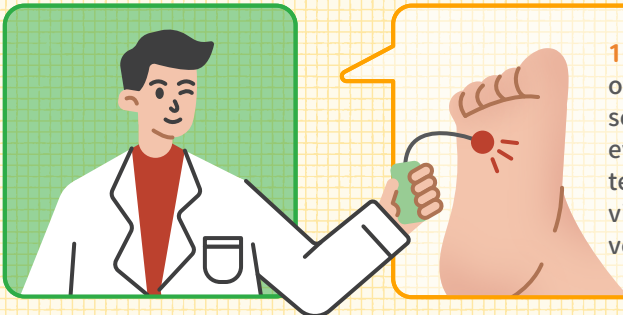
Protective sensation becomes dull or lost, which leads to neglect in foot pressure and injuries and delaying treatment opportunities.

### Peripheral motor neuropathy

Deformation of arches caused by disability **affects foot balance when standing or walking**, causing uneven foot stress.

### Autonomic neuropathy

May affect sweat regulation and lead to **dry, cracked skin**.



**10-gram monofilament test** is one of the common tests of neuropathy; sometimes, physicians also evaluate neurological conditions by temperature, sound wave, vibration, nerve conduction velocity or electromyography tests.

(The doctor is definitely not playing a prank on you by tickling you ~)

## No.2 : Peripheral Vascular Disease

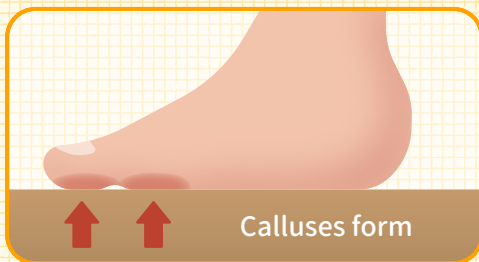
**Poor blood circulation in the lower limbs** caused by peripheral vascular disease may lead to cold hands and feet, terminal tissue hypoxia, and ischemic necrosis.

**Physical examination**, such as palpation of instep pulse, is one of the common methods to evaluate peripheral vascular disease; sometimes physicians may also evaluate the condition by methods such as ultrasound or calculating the blood pressure ratio of upper and lower limbs.

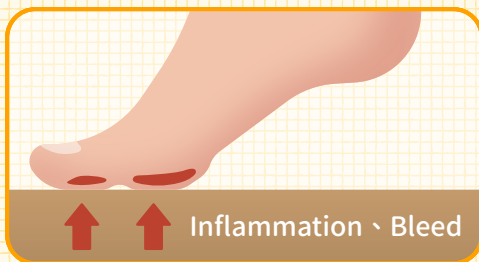


## No.3 : Uneven Foot Stress

Neuropathic and vascular changes enhance uneven foot stress, and the loss of protective sensation causes patients to tend to ignore inflammation, bleeding, and injuries.



**Calluses easily form** on the surface of unevenly stressed foot skin.



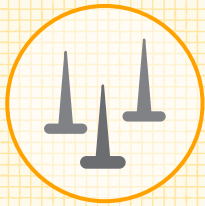
Tissue under calluses may be damaged and inflamed. When these calluses peel off, the subcutaneous tissue is exposed and forms ulcers.

# What symptoms should I be aware of ?

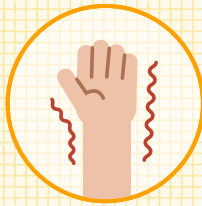
Understand the warning signs of the three major causes of DFU, and report the situation to the medical team immediately to nip it in the bud !

**Be aware of the following symptoms !**

## Peripheral, autonomic neuropathy



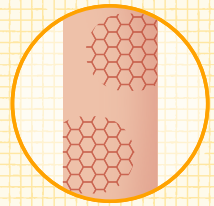
**Stinging pain** in hand and feet



**Numbness** in hand and feet

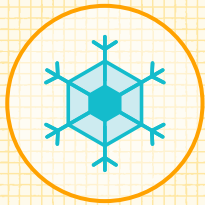


**Abnormal sense of touch**  
(feels like wearing gloves)



**Dry or cracked skin**

## Peripheral Vascular Disease



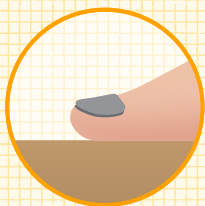
**Cold feeling** in hand and feet



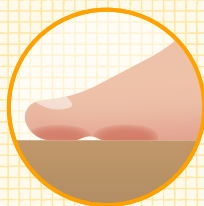
**Intermittent claudication**

Occurs as a result of muscle ischemia, inducing pain and weakness that causes the patient cannot walk but can be relieved by rest.

## Uneven Foot Stress



**Thicken** toenails



**Thick calluses** on soles of feet



**Blisters, wounds**

# Who are the at-risk groups for diabetic foot ulcers?

Check to see if you or your family has a risk factor of diabetic foot ulcers (DFU) :



## Self-check list

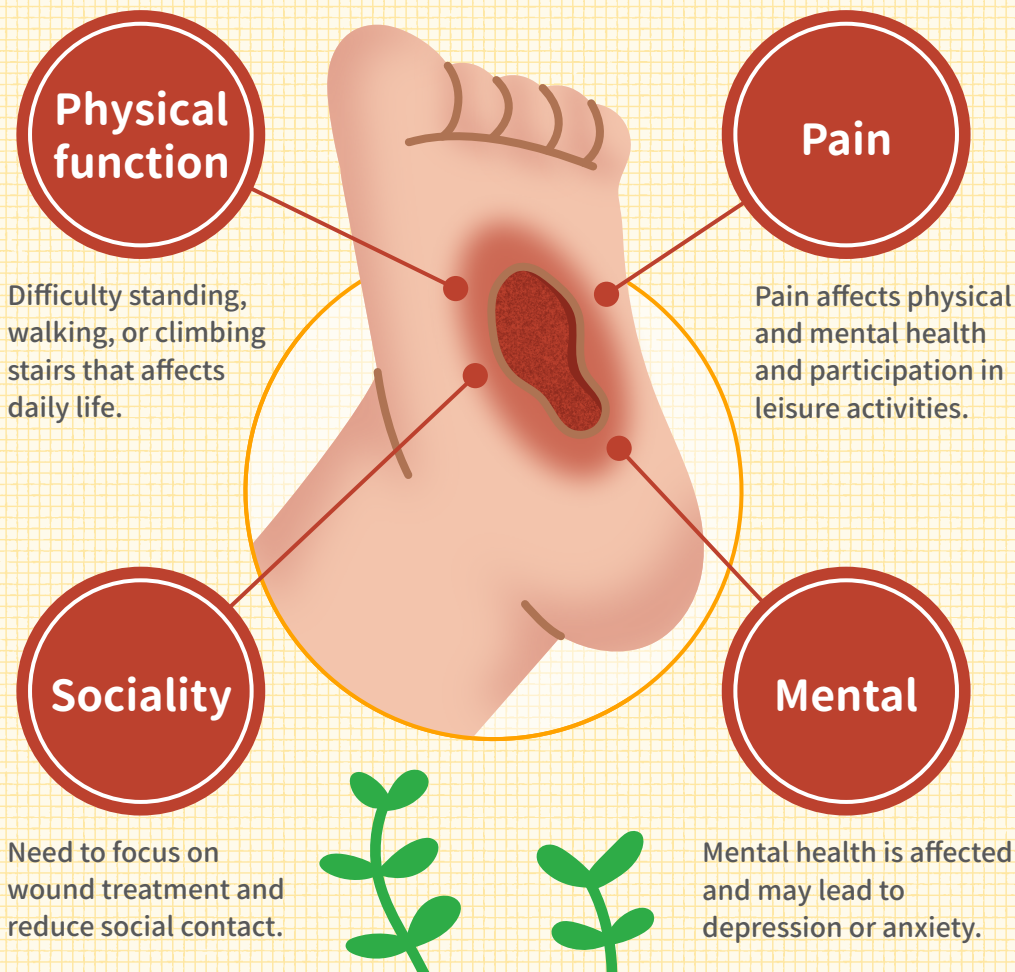
<input type="checkbox"/>	1. Loss of protective sensation (touch, vibration, pain)
<input type="checkbox"/>	2. With peripheral artery disease (cold, cyanosis, limp)
<input type="checkbox"/>	3. Foot deformation
<input type="checkbox"/>	4. History of foot complications: history of DFU or amputation
<input type="checkbox"/>	5. Other diabetes complications: neuropathy, retinopathy, nephropathy

## Check result

Risk level	Risk factors included
0	None of the above
1	With risk factor 1. or 2.
2	With two risk factors from 1.~3.
3	With risk factors 1. or 2., and 4. or 5.

# The impact of ulcer wounds on daily life

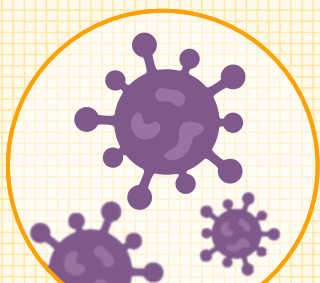
Despite the burden of the wound itself, DFU also greatly affects the quality of life.



The more the wound healing is improved, the better the quality of life and the lower the risk of amputation and death; Good pain control and social and family support can bring great help.

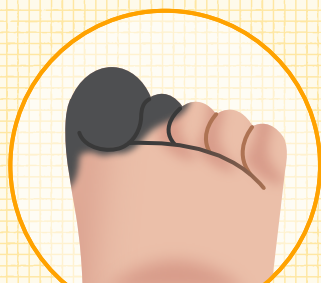
# Common complications of DFU

The longer the ulcer lasts, the greater the impact on daily life. DFU may develop into an infection, gangrene, or even amputation without treatment in time.



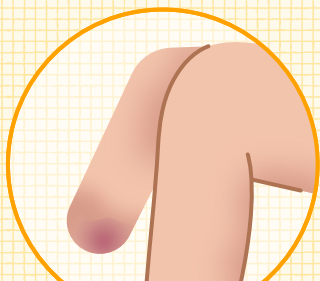
## Infection

The most common complication, the wound enlarges rapidly due to bacterial infection and is the primary cause of lower limb amputation.



## Gangrene

Tissue necrosis due to insufficient blood supply, vascular embolism or infection.



## Amputation

Amputation due to infection or gangrene.

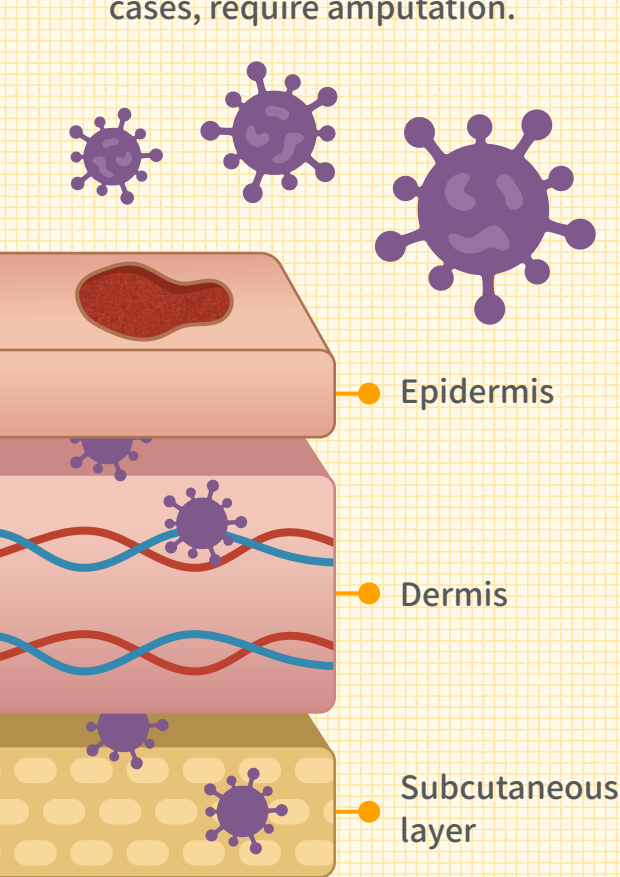


## Death

The risk of death of DFU patients is 2.5 times of diabetes patients.

# Infection : When the disease enters from wounds

Most foot ulcer wounds will be infected by microorganisms, which may require hospitalization and, in more severe cases, require amputation.



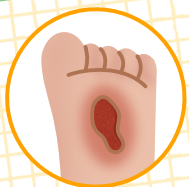
Ulcers cause skin barrier damage, allowing microorganisms to enter.

The infection may reach deep into the dermis and subcutaneous tissue, and even cause septic arthritis, necrotizing fasciitis and osteomyelitis.

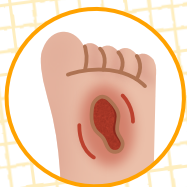
Severe inflammation may cause tissue necrosis and systemic symptoms (fever, metabolic abnormalities, sepsis), which may endanger the affected limb and life.

# When should I go to a doctor immediately ?

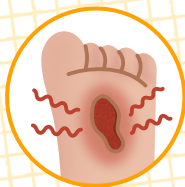
Infection progresses rapidly, you should **seek medical advice as soon as possible when 2 of the following symptoms appear** for early detection and treatment to avoid deterioration.



1. Redness around the wound of 0.5 to 2 mm



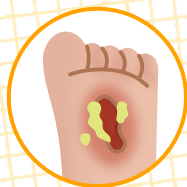
2. Local swelling of the wound



3. Increased local warmth



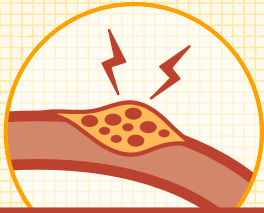
4. Local tenderness or pain



5. Purulent discharge

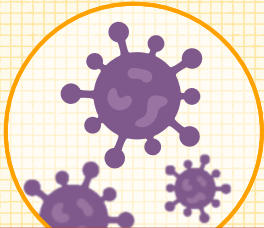
# Gangrene : Ischemic tissue necrosis

Peripheral arterial occlusion- or infection-induced inflammation may cause ischemic tissue necrosis and result in gangrene.



## Peripheral artery disease

- PAD is prone to develop tiny blood clots, causing vascular occlusion.
- Dry gangrene : without infection, tissue dry out and turn black.



## Infection

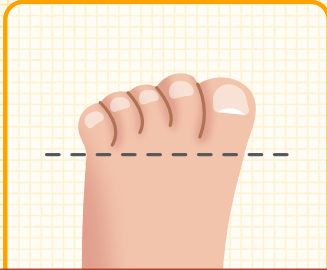
- The inflammatory response caused by infection increases the pressure inside the tissue, thereby hindering blood flow in that area.
- Wet gangrene : tissue is infected, becomes inflamed or rot, and spreads outward.

Gangrene increase the risk of amputation, and should consider hospitalization treatment, debridement, or revascularization surgery.

Start with peripheral artery disease treatment (dredging the bloodstream) and infection prevention to say no to gangrene.

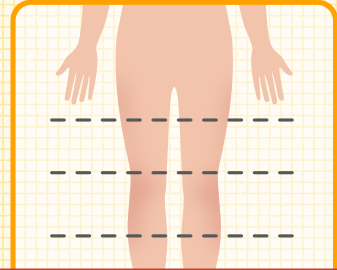
# Amputation : Remove bone or joint

Amputation is a serious complication, with 20% of DFU patients may face amputation.



## Minor amputation

Removal of parts below the ankle, such as toe (The ankle is preserved, patient is able to stand).



## Major amputation

Removal of more extensive parts of limbs, such as below-knee, knee, or thigh amputation (Requires prosthetic limbs to stand).

Amputation may cause :

↑  
Recurrence of ulcer

↑  
Reamputation

↑  
Mortality rate

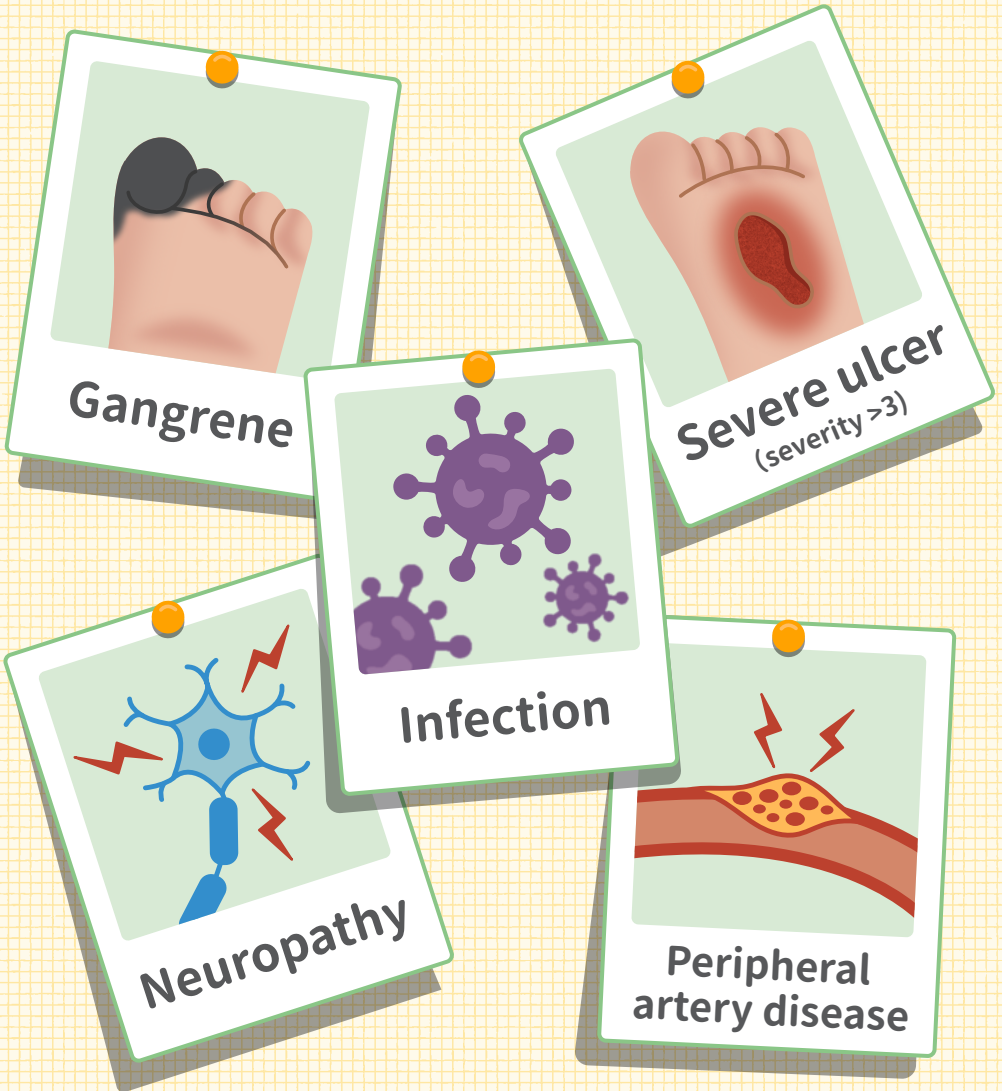
↓  
Physical function

↓  
Quality of life

5-year mortality rate reaches

 **70%**

The major causes of amputation are infection and gangrene, other factors that increase amputation risk :



Preventing the progression of ulcer is the key to avoiding amputation. Combining with the care of a professional medical team could significantly reduce the possibility of amputation.

# Early detection and treatment to prevent recurrence

To prevent ulcer progression or even complications, early detection and treatment are crucial !



## Treat as soon as possible

With appropriate treatment, nearly 80% of ulcer wounds can heal within 1 year.



## Be aware

About 40% of patients occur recurrence within 1 year, and about 60% of patients occur recurrence within 3 years.

**Do not let the guard down even after the wound heals !**



## Prevent recurrence

Return to appointments regularly and keep an eye on the signs of skin damage. Follow the handbook to know more about self-care.

# What treatments will I receive ?

Five main treatment goals of DFU

## 1. Infection management

Use antibiotics correctly according to the doctor's instructions

.....

## 2. Revascularization

To treat peripheral artery occlusion

.....

## 3. Wound care

Debridement and application of dressings to promote wound healing

.....

## 4. Medication and adjunctive therapy

To promote wound healing

.....

## 5. Foot off-loading

Wear assistive devices to off-load foot pressure

# 1. Infection management

If the wound is infected, the doctor may remove the infected tissue by surgical drainage and debridement, and the patient needs to use oral or topical antibiotics according to the doctor's instruction !

## Do I have an infection ?

Check the wound every day, and go to a doctor as soon as possible if the status worsens or  $\geq 2$  of the following situations appear.

Redness

Swelling

Warmth

Pain

Blister

Suppuration



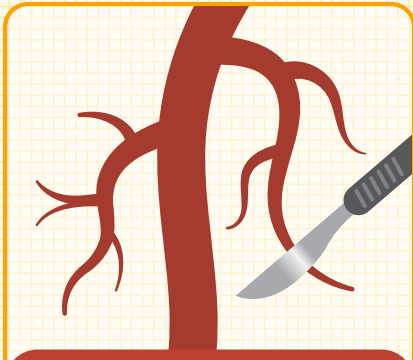
## Say no to resistance !

Do not use antibiotics to prevent infection without infected, but it can be prevented through daily cleaning !

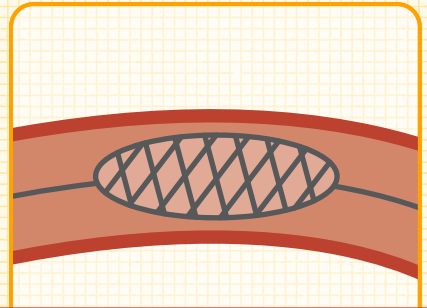
## 2. Revascularization

Revascularization may be needed to dredge the blood flow according the status of vascular occlusion.

May undergo open bypass surgery or percutaneous transluminal coronary angioplasty :



Open bypass surgery



Percutaneous transluminal coronary angioplasty



Increasing blood flow to the patient's foot could effectively promote wound healing and allow antibiotics, oxygen, and nutrients to enter the ischemic and necrotic area, reducing the risk of amputation.

## 3. Wound care

Wound care can create a good wound-healing environment, which includes 3 major elements :

1. Debridement

2. Dressing

3. Off-loading

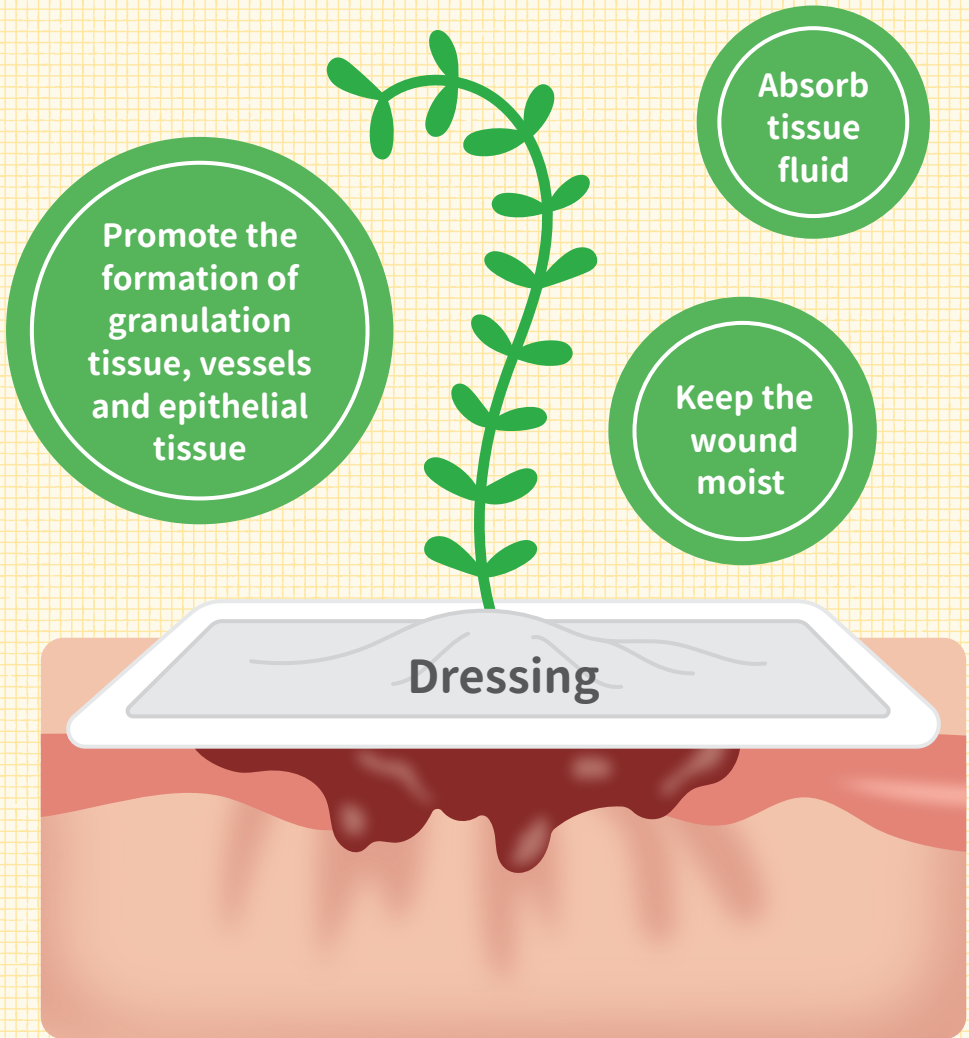
**Debridement** is to clean the wound through surgical or non-surgical methods and promote wound healing.

### How debridement helps wounds heal ?

- Remove the bacteria-infected necrotic tissue
- Promote the formation of granulation tissue
- Promote re-epithelialization
- Remove calluses to prevent inappropriate pressure on the foot



**Dressings** can help absorb tissue fluid exuded from ulcer wounds, prevent damage or further inflammation to surrounding tissues caused by prolonged contact, and keep the wound moist to facilitate healing.

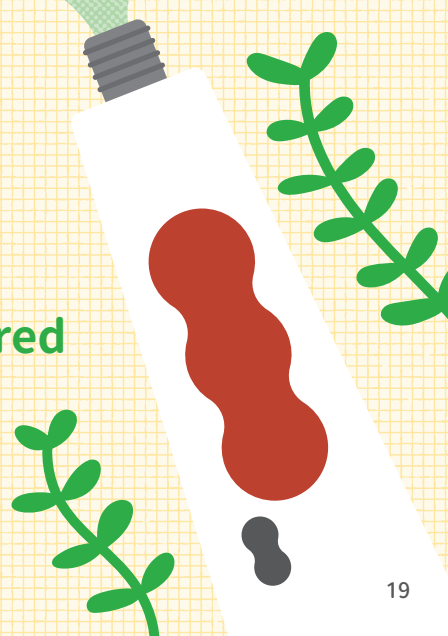


The doctor will choose an appropriate dressing based on the location of the wound, inflammation status, amount of tissue fluid leakage, etc.

## 4. Medication and adjunctive therapy

In addition to debridement and dressings, adjunctive therapy, such as topical medications and negative pressure therapy, can also be used to promote wound repair :

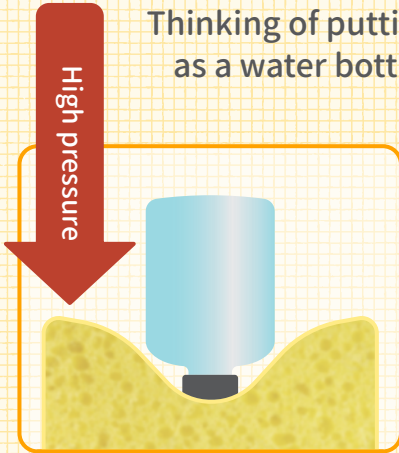
- **Topical medications :**  
ointment containing growth factors ∙  
immunomodulators ∙ plant extract ointment
- **Other oral medications :**  
to improve local blood flow
- **Negative Pressure Wound Therapy :**  
removes wound exudate, improves blood flow and  
promotes granulation tissue formation
- **Oxygen Therapy :**  
promotes wound healing and  
reduces the risk of infection
- **Instrumental Therapy :**  
shock wave, electrotherapy, laser,  
light therapy
- **Skin Graft ∙ Bioengineered  
or artificial dermis**
- **Emerging Therapies :**  
stem cell therapy, gene therapy



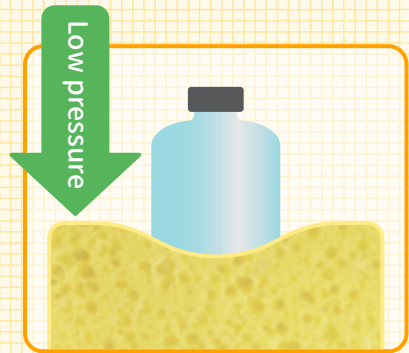
## 5. Foot off-loading

**Foot off-loading is also a key to treatment,** helping to heal and prevent ulcers by dispersing the stress on the feet.

Thinking of putting your feet on the ground as a water bottle pressing on a sponge :



The **smaller the contact area** with the sponge and the more depressions the sponge has, the **greater the pressure**.



The **larger the contact area** with the sponge, the fewer depressions the sponge has, indicating that the **pressure is dispersed**.

The medical team will choose the foot insole or assistive device that suits you based on the location of the wound, ischemia status, whether the wound is infected, and foot deformation to help distribute the pressure on the feet.

Even if blood circulation is average and the wound has healed, failure to off-load appropriately will delay wound healing and increase the risk of ulcer recurrence.



# Foot protection

Even if ulcers do not occur, daily foot care is important to prevent ulcers !

## Watch

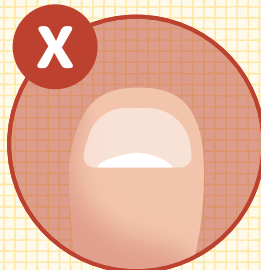
- Check your feet daily for cuts, calluses, swelling, deformation, or any symptoms that may need medical advice. (see handbook p4)

## Wash

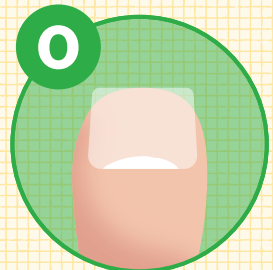
- Wash your feet with warm water every day, avoid soaking your foot regardless of whether there is a wound or not.
- Moisturize your feet with lotion if there are no wounds, but should avoid toe web.

## Trim

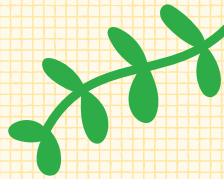
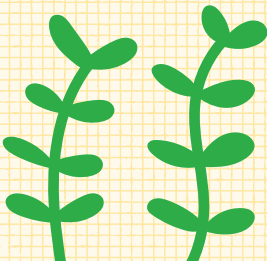
- Trim your nails regularly and cut toenails straight across.



Incorrect



Correct



# Wear

- Wear shoes and socks to avoid injuries caused by walking barefoot.

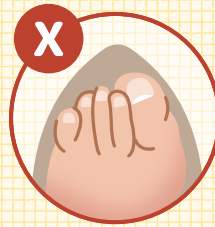
## How to choose socks ?

- Wear seamless or light-colored socks.

## How to choose shoes ?

- Wear diabetic shoes, modified footwear, or customized therapeutic footwear/insole recommended by a medical professional.
- Check if your shoes fit your foot : the internal length of the shoes should be 1-2 cm longer than the foot, and there is enough space for toes to move.

## How to choose shoes



Incorrect



Correct

## Reminder !

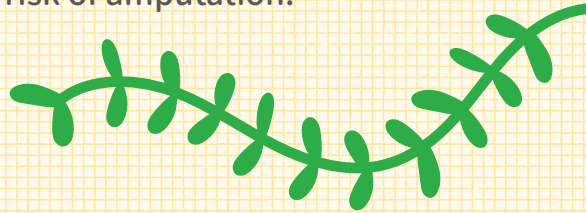
- Before putting on shoes, check the inside of shoes with your hands for foreign objects to avoid injury.
- Never wear shoes that are heavy-wore or have caused a DFU before.



# Good blood sugar control

Good blood sugar control can prevent peripheral neuropathy and the development of ulcers.

Even if a foot ulcer has already developed, good blood sugar control can promote wound healing, reduce infection, and reduce the risk of amputation.



**Glycated Hemoglobin HbA1c**  
should be controlled

**<7%**

For every **1% decrease in**  
**glycated hemoglobin**

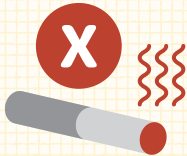
→ Wound healing area **increased by 0.028 cm<sup>2</sup>.**



# Healthy lifestyle

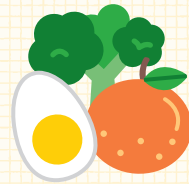
Maintaining a good lifestyle can promote the overall health of DFU patients and can also improve the quality of life, and physical and social functions, let's start the following lifestyles from today :

## Quit smoking



- Smoking delays ulcer healing and increases the risk of amputation.

## Eat healthy



- Supplement vitamin C, D and protein intake.

## Workout healthy



- Exercise with suitable shoes is recommended.
- Exercise can reduce the risk factors for ulcers (peripheral artery disease, peripheral neuropathy) to prevent the occurrence of ulcers.

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This manual is intended for health and education use by medical professionals only.

If you have any questions, please feel free to seek professional medical advice.