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The Peer Reviewed Journal of Clinical Practice

Diabetic foot care

Reprint Collection

Frank's flat feet

Helen's high arch

Carol's clawed toes

Bob's bunions

Pam's pigeon toes

Don's duck feet

Foot care FAQs



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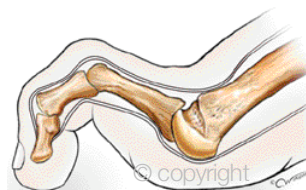
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Help your patients with diabetes to look after their feet. Give them a copy of this handout that answers questions often asked about foot problems and foot care.

The articles in this supplement were originally published in *Medicine Today* in 2005 and 2006.

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Frank's flat feet

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PAT J. PHILLIPS MB BS, MA (Oxon), FRACP, MRACMA, Grad Dip Health Econ (UNE)

This series on the foot care of patients with diabetes focuses on the importance and assessment of foot structure. An altered, 'misshapen' foot is an important risk factor for diabetic foot ulceration, like vascular and neurological deficits.

The first article in this series addresses one of the basic foot structure types, the flat foot, and its associated pressure patterns and footwear needs. An appreciation of foot structure and the pressure areas in stance and gait is important. A simple check of foot structure and pressure areas can be included in the regular six-month foot check of your patients with diabetes (Table).

Case history

Frank is 23 years old with an eight-year history of type 1 diabetes that is well managed. His height is 1.84 m and weight 81 kg; thus his BMI is 23.92 kg/m² (i.e. he is in the healthy weight range). His HbA_{1c} is 6.5%, and he has had no hypoglycaemic episodes requiring external help.

Frank has normal foot pulses, healthy skin and no clinical evidence of peripheral neuropathy. He is a good footballer, plays tennis and likes to swim. His last football season was dogged by 'shin splints' (medial tibial stress syndrome), and he also had problems with callus build up (Figure 1)

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and sometimes blistering of the skin adjacent to the first metatarsophalangeal joint and the big toe. The weight-bearing areas of the feet show callus build up and his feet look quite flat when he stands and walks.

Questions to consider

- How might Frank's foot structure be contributing to his problems?
- How would you assess this?
- What can be done to help Frank?

Frank's foot structure

The distribution of Frank's callus and blisters is characteristic of a flat foot responding to a high load.

- A foot with a normal arch distributes pressure evenly over the foot during the foot strike cycle (Figure 2, left).
- A flat foot concentrates the load on the inner medial side (Figure 2, right), with particularly high loads over the first metatarsophalangeal head and toe, which is Frank's problem.
- A foot with a high arch loads the metatarsophalangeal heads and the terminal phalanges and may also put pressure on the dorsal phalangeal joints once toes become clawed.

For Frank the problem is a nuisance, but in the future if, or when, he develops neuropathy and/or vascular disease his foot structure would be very likely to precipitate a foot ulcer. The current problem is an early warning and should be responded to.

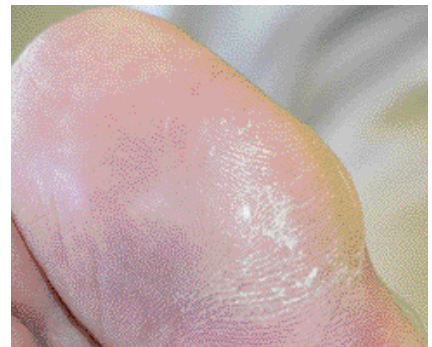


Figure 1. The callus on Frank's big toe.

Assessing Frank's foot

Look at Frank's soles for areas of callus (the skin's response to pressure). Check the typical pressure areas (as indicated above). Pick up Frank's shoes and see if they look like the shape of his feet. Check the shoe condition: shoes that have 'bumps' in the uppers are rubbing on the feet, and shoes that are worn out or have worn to form a slope to the side will not help Frank's gait or standing position.

Ask Frank to stand, and look at his foot position under his legs. Do they look straight, everted (flat arch) or inverted (high arch). What happens when Frank walks? Do his feet stay straight or roll to one side or the other?

Finally, while Frank is wearing his shoes, check how he stands and walks again. Do the feet look straighter with his shoes on, or do they appear to roll in or out more than when he was barefooted (Table)? In other words, do the shoes help to correct a problem or make it worse?

Helping Frank

If you see pressure areas on the feet (corns or calluses) or if the footwear and feet don't work well together, a podiatrist assessment might be helpful. Removal of the callus reduces the load by 20% (by stopping the concentration of force over a small area),¹ and appropriate footwear, socks and insoles can each further reduce loads by 20% (total reduction 50% for these three measures). Orthotics can be designed to deflect loads away from high pressure

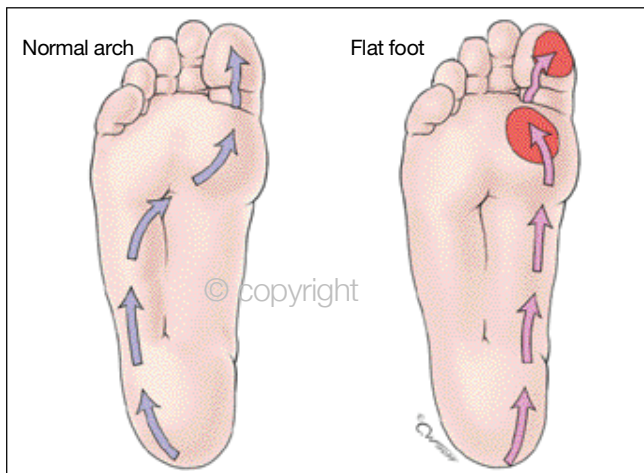


Figure 2. Left. The gait of a foot with a normal arch. Pressure is distributed evenly over the foot during the foot strike cycle. Right. Frank's gait. A flat foot concentrates the load on the inner medial side with particularly high loads over first metatarsophalangeal head and toe.

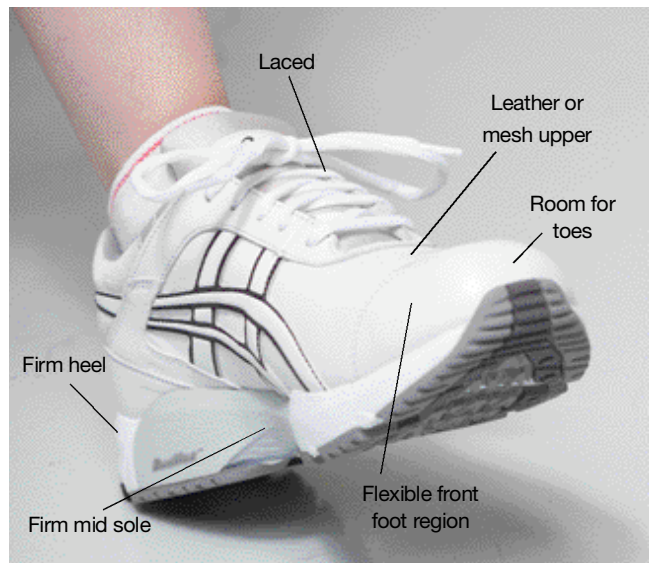


Figure 3. Features to look for when choosing a sports shoe.

areas.^{2,5} Compensating for dysfunctional foot structure spreads the load and restores the mechanics of the foot and leg.

The most important point is to prevent problems like Frank's calluses, blisters and shin splints developing so that he can continue his active sporting interests. If you were unsure about Frank's foot structure, a podiatrist might help by providing advice on footwear.

A stable shoe will support the foot as it loads, yet allow for adaptation to different surfaces and while moving and turning (Figure 3). Flexibility across the forefoot is important so the foot can push forward,

and lacing can keep the foot in place, reducing the friction that might otherwise cause blistering. If an orthotic is needed the shoe should be deep enough to incorporate this without compromising foot protection and foot function. The upper should allow for cooling by airflow evaporation. Football or soccer boots should be selected with particular care because of their limited depth.

There is no substitute for fit; the sports shoe should be fitted while the person is wearing the socks that will be worn to play the sport involved. Advise your patients to seek out specialist sporting

footwear shops where the staff are trained to measure and fit footwear effectively.

Although not relevant in Frank's case, foot problems may be precipitated and/or aggravated by being overweight. **MT**

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Table. What to look for at the foot structure check up

Factors	Feet	Footwear	Gait
Nonweight-bearing factors	<ul style="list-style-type: none"> • Plantar calluses • Dorsal pressure areas • Arch shape 	<ul style="list-style-type: none"> • Shape • Sole 	Not applicable
Weight-bearing factors	<ul style="list-style-type: none"> • Normal • Flat: rolled in • High arch: rolled out 	<ul style="list-style-type: none"> • Do the feet lean in or out of shoes? • Are there pressure areas over toe regions of the shoes? 	<ul style="list-style-type: none"> • When barefooted, do the feet roll in or out, or stay straight? • Do shoes change the barefoot gait pattern? Is this better or worse?

Helen's high arch

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Patients with diabetes who have both high arched feet and peripheral neuropathy are at increased risk of foot ulcers. Here are some issues to consider in managing such patients.

Case history

Helen is 67 years old and has a 14-year history of type 2 diabetes that generally is well managed. She has normal foot pulses, dry but healthy skin, and clinical evidence of peripheral neuropathy with both vibration and pressure perceptions absent in the forefoot and mid foot and then reduced to the level just above the ankles.

Helen tries to walk for exercise to help blood glucose and weight control, but she

often feels unstable on her feet and previously sprained both ankles when she used to play tennis. Her shoes are a slip-on, court style that show very worn down lateral heels and pressure 'bumps' over the toes in the shoe upper. She has a thick callus adjacent to the first metatarsal heads on both feet.

Helen says the weight bearing areas of the feet have shown callus build up in these regions for many years, but it is only in the last week that she noticed some blood on her right stocking and made an appointment to see you. She has an ulcer on her right foot surrounded by callus (Figure 1).



Figure 1. The ulcer and callus on Helen's foot.

Questions to consider

- Why has Helen developed this ulcer?
- How should the ulcer be managed?
- How can you assess Helen's foot

structure and footwear?

- How can a recurrent ulcer be prevented?

Why Helen has developed this ulcer

The main reason why Helen has developed this ulcer is her neuropathy. Damage to the sensory nerves has led to loss

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Table 1. Helen's foot health and action needed

Risk factors for ulcers	Helen's right foot	Action needed for Helen
Vascular	Healthy	General care
Neurological	Non-sensate	Education on injury risk
Self-care	Good	Daily visual checks of feet
Foot structure	Pressure areas	Use of orthotics and appropriate footwear that complements her foot type – probably an extra depth style of shoe to accommodate her high arch
Past ulcer	Newly developed foot ulcer	Debridement, dressing, off-loading of pressure and watching for infection

of sensation and lack of pain has allowed her to tolerate damage that led first to her callus and then to the ulcer.

Damage to the motor nerves has led to muscle atrophy and thus to accentuation of the foot arch and clawing of her toes. The loss of intrinsic muscle stabilising of the metatarsophalangeal joints means the extensor pull is effectively unopposed and hence the toes retract (bearing less weight) to expose the metatarsal heads to peak forces. The abnormal foot structure has altered the normal distribution of pressure and overloaded her metatarsal heads, producing areas of callus and then the ulcer.

Helen's neuromuscular changes are consistent with her longstanding diabetes and neuropathy. More severe neuromuscular disturbance should prompt systematic review seeking some underlying neuromuscular disease such as Charcot-Marie-Tooth disease.

Damage to the autonomic nerves has led to loss of sweating and her dry skin. Fortunately, Helen has taken good care of her skin with moisturiser and has not developed any of the cracking often associated with dry skin. As shown in Table 1, Helen now has three of the five major risk factors for foot ulcers.¹ On the positive side, Helen has good circulation and takes good care of her feet. With appropriate management, the ulcer should heal.

Managing Helen's ulcer

'It's not what you put on an ulcer that helps; it's what you take off that's important.' The key point is: take off any debris and take off any pressure.²⁻⁴ Keep the ulcer clean, moist and as undisturbed as possible (Figure 2). If the blood supply is adequate, the ulcer will heal. Removing any debris or pus cleans the ulcer, and removing the callus takes away part of the pressure that would otherwise damage the healing ulcer and retard or prevent healing.

A podiatrist could further reduce pressure loads by adding an orthotic device to Helen's shoes that will more evenly distribute the load, reducing pressure on the first metatarsal head ulcer and the callused area of the forefoot.

Reducing the pressure will reduce the tendency to callus formation in the long term. However, any callus that recurs should be removed and the suitability of orthotics reviewed regularly.

Calluses and corns are indicators of excess loads on the area and may also point to neuropathy, allowing the person to tolerate the damage that leads to callus or a corn and then to an ulcer.

Should the patient's ulcer not show obvious healing, it is recommended that he or she be referred to a diabetes foot clinic for assessment and management by a multidisciplinary team specialising in more complicated foot ulcerations.

Assessing Helen's foot structure and footwear

Look at Helen's feet and gait while she is sitting, standing and walking, first without and then with the footwear that she uses every day (Table 2).⁵

Helen has a high arch. This leads to abnormal biomechanics and foot loading when she walks (Figure 3). The excess load is reflected in the pattern of wear of her shoes and the distribution of callus on her feet. As she walks, the high arch makes her foot roll out as she 'pushes off' from the lateral side of her forefoot rather than the medial side.

Do Helen's foot and gait look better, no different or worse when she is wearing shoes? Appropriate footwear should largely or completely compensate for the abnormal structure and lead to a more normal standing posture and walking gait.



Figure 2. Immediate ulcer care should include a moist wound dressing to cover the ulcer and a deflective pad to off load pressure.

Table 2. What to look for at the foot structure check up

Factors	Feet	Footwear	Gait
Nonweight-bearing factors	<ul style="list-style-type: none"> • Plantar calluses • Dorsal pressure areas • Arch shape 	<ul style="list-style-type: none"> • Shape • Sole 	Not applicable
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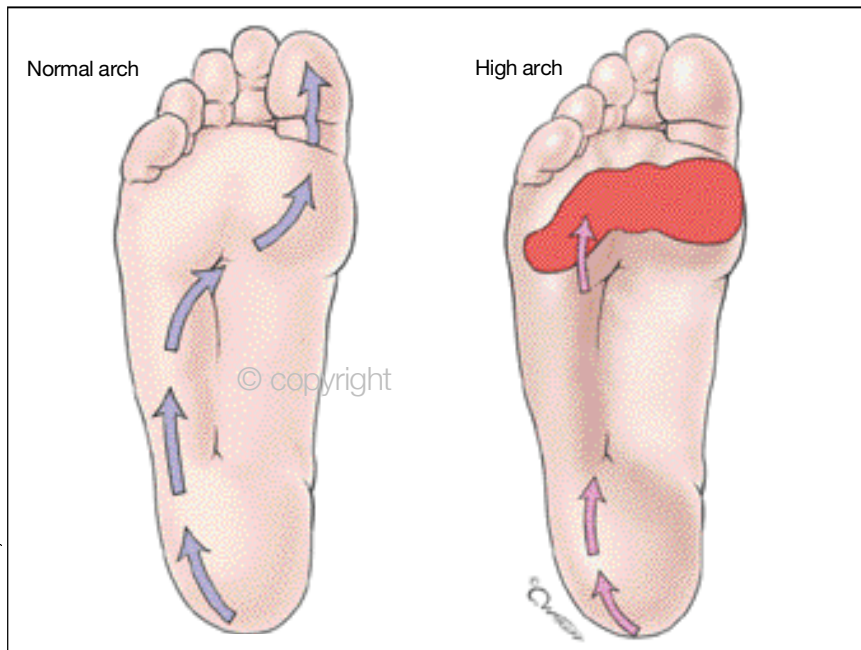


Figure 3. Left. The normal force line along the weight bearing aspect of the foot during gauge. Right. A high arch makes the foot roll out as the person ‘pushes off’ from the lateral side of the forefoot rather than the medial side.

Preventing ulcer recurrence

Helen already takes reasonable care of her feet but could probably decrease skin dryness by:

- reducing factors causing dryness, such as soap and exposure to water (especially hot water) and the air
- increasing the moisturiser schedule, such as the frequency and/or the oil content of the product used (for example, switching from a lotion to a cream).

Helen’s footwear is obviously not ideal since she developed the ulcer in the first place. She should wear shoes to accommodate both her feet and orthotic insoles. Helen’s toes are retracted at the metatarsophalangeal joints, which means that extra depth footwear is required to

avoid pressure over the dorsum of the toes. Because she has neuropathy and has lost her sensation of pain, she may not feel pressure that is damaging her feet and may not take action to reduce that pressure.

A podiatrist can assess Helen’s foot function and address this with a combination of appropriate footwear selection and orthotics to support and cushion her feet. It is likely that Helen will need specific footwear, although some athletic footwear can often be adapted.

Should further callus develop, it should be removed by Helen (for example, using a pumice stone after a shower), her general practitioner or her podiatrist.

A stable shoe will support the foot as it loads, yet allow for adaptation to

different surfaces and while moving and turning. Flexibility across the forefoot is important so the foot can push forward. The lacing technique also needs to be addressed to ensure the best fit and reduce the chance of friction, which can cause blistering or ulceration. If an orthotic is needed, the shoe should be deep enough to incorporate this without compromising foot protection and foot function. The upper should allow for cooling by airflow evaporation.

An added bonus for Helen if she wears the appropriate footwear will be improved stability while standing and walking, which is important since she is in an age group in which falls become more common and can cause a fractured wrist or hip.

MT

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Carol's clawed toes

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The motor neuropathy that may occur in patients with diabetes can lead to an imbalance between extensor and flexor function and result in 'clawing' of the toes. Here are some issues to consider in managing diabetic patients with neuropathy and clawed toes.

Case history

Carol is 68 years old and has had type 2 diabetes for 16 years with moderate diabetes control (HbA_{1c} values ranging between 7 and 8.5%; ideal <7%). She has always been embarrassed by her flat feet and over the last few years has developed clawed toes (Figure 1), which she now finds a problem as shoes often rub her toes. She has angina but tries to walk each day on a flat path and at a gentle pace. She is worried about foot infection and knows that poor shoe fit can cause blisters or abrasions that could become infected. She doesn't feel her toes rubbing, but when she returns from her walk and takes off her court shoes, she can see that her buckled toes are quite reddened.

Carol has reduced dorsalis pedis and posterior tibial pulses in both feet and reduced sensation to her mid foot, but her skin and nails are well cared for. She regrets smoking for some 35 years when she was younger.

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Questions to consider

- Why has Carol developed clawed toes?
- What factors relevant to Carol's clawed toes do you need to assess?
- How can Carol's footwear be improved?
- What else can Carol do to reduce her risk of future problems?

Why clawed toes have developed

Carol's toes have clawed for two main reasons.

- She has flat feet so the toes will often claw more in an attempt to grip the ground and give the stability that her foot structure does not provide. The extensor and flexor balance around the metatarsophalangeal and interphalangeal joints is disrupted and the toes buckle (see Figures 2a and b). The net effect is less toe push in gait (the toes grip instead), increased load on the weight-bearing aspect of the metatarsal heads and tips of the toes, and a shortened, higher forefoot to fit into a shoe.
- Carol also has sensory neuropathy, and since the motor nerves can also be affected, the extensors and the flexors pull unevenly and further buckle the toes. She is unlikely to have pain when the metatarsals and tips of the toes bear more weight and develop thick calluses, or when the clawed toes rub on the upper of the shoes.



Figure 1. Carol's clawed toes.

Factors that should be assessed

The fit and style of Carol's shoes are issues that should be considered immediately as the wrong shoe will cause abrasions or blisters over the clawed toes and risk potential infection. Carol will not be able to feel whether or not her shoes fit comfortably.

Look for pressure sites, especially over the interphalangeal joints of the clawed toes, but also the weight-bearing metatarsal heads.

As Carol has flat feet it may be helpful also to address the mechanical effects of this. A podiatrist who is well versed with

Table 1. Foot factors that predispose to foot ulcers

Vascular disease

Reduced healing
Increased risk of infection

Neuropathy

Damage becomes painless
Dry skin cracks

Foot structure

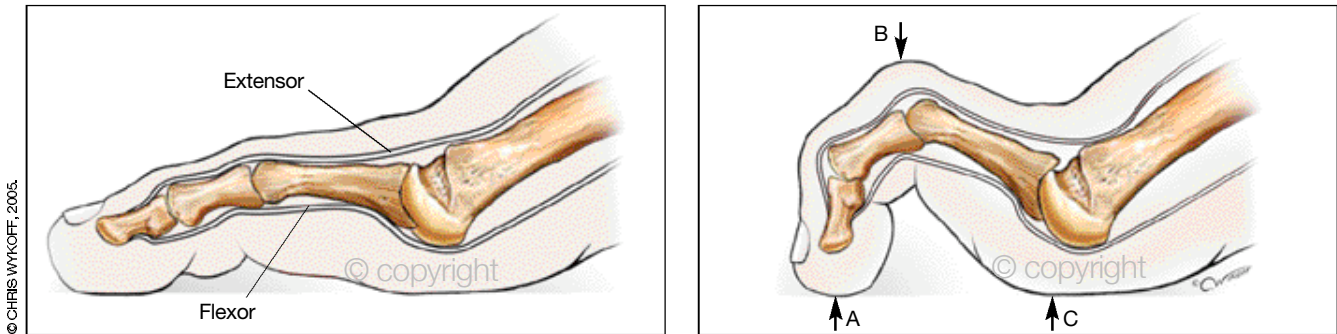
High pressure areas

Self-care*

Inadequate or inappropriate footwear
Poor skin and nail care
Lack of monitoring schedule, action plan or access to health professionals

* Note that patients may not be able to see, reach or feel their feet.

continued



Figures 2a and b. a (left). Simplified illustration of a normal foot. There is an even and balanced function between the digital extensor and flexor that stabilises the interphalangeal and metatarsophalangeal joints. b (right). Carol’s clawed toes. Motor neuropathy can reduce extensor function and result in an imbalance between extensors and flexors. The net effect is increased flexion of the interphalangeal and metatarsophalangeal joints that results in ‘clawing’ of the toes. This illustration also shows the three likely areas of increased pressure (A, the digit apex; B, the proximal interphalangeal joint; C, the plantar metatarsal head) that are potential sites of ulceration if the pressure is not off-loaded.

both diabetes and foot mechanics should be able to help.

Improving footwear

Carol’s feet need protection. Her altered foot shape now means that shoes can damage the feet unless they are carefully selected and fitted. The neuropathy means that her toes will continue to claw and she will not be aware of any local abrasion taking place on the toes or ulceration under the metatarsal head calluses.

Pressure should be off-loaded, both weight borne and over the toes. Insoles or orthotics can assist in protecting the plantar surfaces and may reduce some of the toe clawing, but these can also fill up the shoe even more and footwear may need review. Carefully debride callused areas and thereby immediately reduce 20 to 30% of the load pressure.

Fit the feet in deeper toe box shoes. Some athletic shoes can be suitable if the sock liners are removable; such shoes will also provide good cushioning for Carol’s walking program.

The socks also need special consideration as bulky styles can take up a lot of room and cause blisters. The major priority is to prevent any skin breakdown that could progress rapidly. Carol may not be able to feel the damage and the blood flow may not be enough to enable healing.

Helping reduce the risk of future problems

Carol has three of the four foot factors predisposing to foot ulcers (Table 1).¹ These factors set the priorities for Carol’s self-care program (Table 2).¹ She also needs to be given an action plan so that

she knows what to do if she notices a problem or has questions about her feet or self-care schedule. Address the basics first – advise her on the importance of:

- visually checking her feet (if necessary using a mirror to check the soles)
- caring for her skin, especially using moisturiser to prevent cracking
- debriding calluses – e.g. with a pumice stone after her bath or shower
- wearing well selected and fitted shoes
- using an orthotic or insole to off-load any weight-bearing areas
- possibly, wearing pressure-reducing socks (e.g. Thor-lo) for daily walks
- having a check up with her GP or podiatrist every six months to review the status of her feet and update her care needs.

Carol should also be given a ‘hotline’ to contact her GP or podiatrist as soon as foot problems develop. MT

Risk factor	Hygiene	Inspection	Protection
Vascular disease	++++	+	++++
Neuropathy	++	+++	++++
Foot structure	+	+	++++
Self-care	++++	+	+

Scale: ++++ = essential; +++ = very important; ++ = important; + = advisable.

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Bob's bunions

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Bunions are a common problem in patients with diabetes, particularly those who have neuropathy. A proactive approach in tackling correctable factors will help to ensure patients with bunions keep walking comfortably.

Case history

Bob is 58 years old and obese (his height is 175 cm and weight 81.4 kg, so his body mass index is 31.2 kg/m²). He has moderate bunions on his feet (Figure 1), and in the past two years these have been painful enough at times to restrict his walking program.

Apart from mild hypertension for the past eight years (controlled with an ACE inhibitor) and type 2 diabetes for the past six years (moderately controlled by trying to eat less and walk more; HbA_{1c} 7% to 8%), Bob is generally healthy. The only other medication he takes is low dose aspirin (enteric coated 100 mg/day).

Bob's father also had bunions, for which he had surgery; one bunion resolved but the other one deteriorated.

Bob has also noticed increasing cramping of his calf muscles. He has found it more comfortable, and has self-selected, to wear a shoe with a built-up heel to reduce the cramping. He has normal foot pulses and sensation in his feet. He uses a pumice stone to remove the callus that builds up over the first metatarsal heads and has started to wear very soft shoes that don't rub his bunions.

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Figure 1. The bunion on Bob's right foot.

Questions to consider

- Why has Bob developed bunions?
- What factors should you assess?
- How should Bob's bunions be managed and future problems reduced?
- How should Bob's progress be monitored?

Why bunions have developed

The main reason that Bob has developed bunions is his flattened foot type and the rounded shape of his first metatarsophalangeal joints (rounded joints are less

stable than normal, square-shaped joints). It is likely that his father also had these features. With time, Bob's feet have developed flatter, longitudinal arches, partly because of his intrinsic foot structure and partly because of his gait. Flattening the arch changes the loading of the foot. This

Table. Checklist for patients with bunions

Factor	Points to note
Familial	Round first metatarsophalangeal joints, short first metatarsal (Morton's foot) and flat feet are predisposing factors to bunion development.
Age	Juvenile bunions are usually due to unstable first metatarsophalangeal joints, ligament laxity and/or family foot type.
Foot structure	Flat feet put increased forces on the first metatarsophalangeal joints and encourage the bunion deformity.
Calf length	In addition to bunions, tight calves are associated with Achilles tendon, heel pain and leg cramps.
Bunion size	Larger bunions rub on shoes but are not always painful.
Discomfort	Discomfort may be constant or felt only with particular shoes, and may limit activity.
Footwear style	Pointed shoes push the great toe laterally and increase the bunion prominence.
Heel height of footwear	The higher the heel, the more load on and flexion of the first metatarsophalangeal joints.
Diabetes	If the patient has neuropathy, callus forms more easily because discomfort from pressure is not perceived. Address all aggravating factors to reduce bunion development and offload an existing bump.

becomes self-reinforcing since the load concentrates on the medial side, further flattening the arch. Loading is also being changed by his tight calves, which reduce flexion at the ankles and increase load on the medial forefoot, particularly over the first metatarsophalangeal joint.

Factors that should be assessed

The factors that should be assessed in any patient with bunions are summarised in the Table.

Managing Bob's bunions and reducing future problems

Bob's bunions are now troublesome enough to stop him from walking. In turn, this affects control of his blood glucose, blood pressure and weight. As mentioned above, the main aggravating factors for his bunions are his flat feet, the shape of his first metatarsophalangeal joints and his tight calves (hence his need for built-up heels to avoid cramps). We can't alter Bob's inherited foot type or the fact that he already has sizeable bunions. However, the other factors that make his feet less functional and cause him discomfort can easily be addressed.

- **Flat feet.** Bob should wear well-designed, supportive orthotics to offload the medial side of the foot and the first metatarsophalangeal joint.¹
- **Tight calves.** Calf stretches (gastrocnem-

ius and soleus groups) are effective at increasing ankle range and reducing first metatarsophalangeal joint loading.²

- **Footwear.** Footwear should be selected to incorporate appropriate orthotics and accommodate the bunions without pressure, and be suitable for regular walking.³ Orthotics may need to be customised for each individual foot, or generic versions may be used if they are effective for the particular patient concerned. Once the calf muscles are adequately stretched, the need to incorporate a heel raise or higher shoe heel will be eliminated and these muscles can work at normal functional length. Athletic footwear bought off the shelf is often very useful to incorporate varying foot shapes, and provides good width and support. This type of footwear is usually acceptable for people to wear, encourages exercise and can avoid the need for more expensive customised footwear.

If the bunions cannot be adequately accommodated in footwear or continue to progress and become painful despite the measures noted above, it is wise to consult with an experienced surgeon who specialises in bunion surgery.

Monitoring progress

Bob's progress can be monitored by

assessment of his foot pain, calf length, callus build up and walking distance. He may also lose some weight and reduce his blood pressure (and possibly his medication).

Summary

It is important to work through the bunion checklist (see Table) as soon as you see a patient with bunions. Don't wait for patients to complain that their bunions are painful. Be proactive and work with a podiatrist to tackle the correctable factors; keep people like Bob walking and comfortable. MT

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Pam's pigeon toes

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Correction of structural and functional foot problems, such as pigeon toes, can help patients with diabetes to increase their level of activity and fitness, lose weight, and, subsequently, improve their glycaemic control and level of comfort.

Case history

Pam is 63 years old and has had type 2 diabetes for five years. Recently, her blood glucose control has not been ideal, with HbA_{1c} values ranging from 7.9 to the current 8.8% over the last year (an ideal HbA_{1c} is <7%). Pam is overweight (weight 61.2 kg; height 1.5 m; BMI 27.2 kg/m²). She takes metformin 850 mg twice daily and glipizide 10 mg twice daily.

You suggest that Pam increases her activity to help bring her blood glucose under control. Pam says she finds any form of walking difficult because she has corns that 'hurt like hell' and unstable ankles that turn laterally 'at the drop of a hat'.

On examination you note the obvious corns on the lateral aspect of both fifth toes, and that the nails of these toes are thicker than the other toenails. The soles of her shoes are worn down laterally, and the shoes are an unusual shape, curving medially from heel to toe. There is a clear

dent over the forefoot where the fifth toes are pushing. Pam explains that she always chooses soft leather shoes to minimise pressure on her corns. When she stands and walks, her feet point inward but her arch and heel angle look normal (Figure 1).

Questions to consider

- Why is Pam pigeon toed?
- How can you assess factors that are contributing to Pam having pigeon toes?
- How can Pam's footwear be improved?
- How can Pam's risk of future foot problems be reduced?

Why Pam is pigeon toed

The usual cause of pigeon toes in adults is a persistence of rotation of the whole lower leg by inward femoral twisting that does not correct itself during childhood. This inturning may be aggravated by tight hamstrings and calves, which limit any extension and tend to induce medial leg rotation when walking. Tight calves may also limit the range of movement of the ankles, reduce ankle stability and increase the tendency towards inversion sprains.

In addition to the above, Pam's previous ankle injuries, caused by her unstable ankles, have progressively weakened her ankle joints, further increasing ankle instability.

The total effect can be understood by



Figure 1. Pam's pigeon toes.

trying the following: walk with toes pointed inwards and with slightly flexed knees and ankles. The foot will strike the ground on the lateral forefoot, the flexed ankle will encourage inturning and the flexed knee will increase the tendency to stumble and put the whole body weight on the inverted, flexed, unstable ankle.

Assessing contributing factors

As with all foot problems, check Pam's feet, her gait, her footwear and her foot-care.

Look at Pam's feet while she is standing and walking barefooted. See how much her feet point in when standing and whether the inpointing increases during walking. Can she stand with her feet flat, knees fully extended and back straight? If she can, how close can she get to touching her toes?

Standing with feet inpointing suggests femoral torsion. Inpointing that increases while walking as well as an inability to stand with flat feet and extended knees or limitation of hip flexion suggest tightness of the calves and hamstrings.

The soft leather of Pam's shoes may

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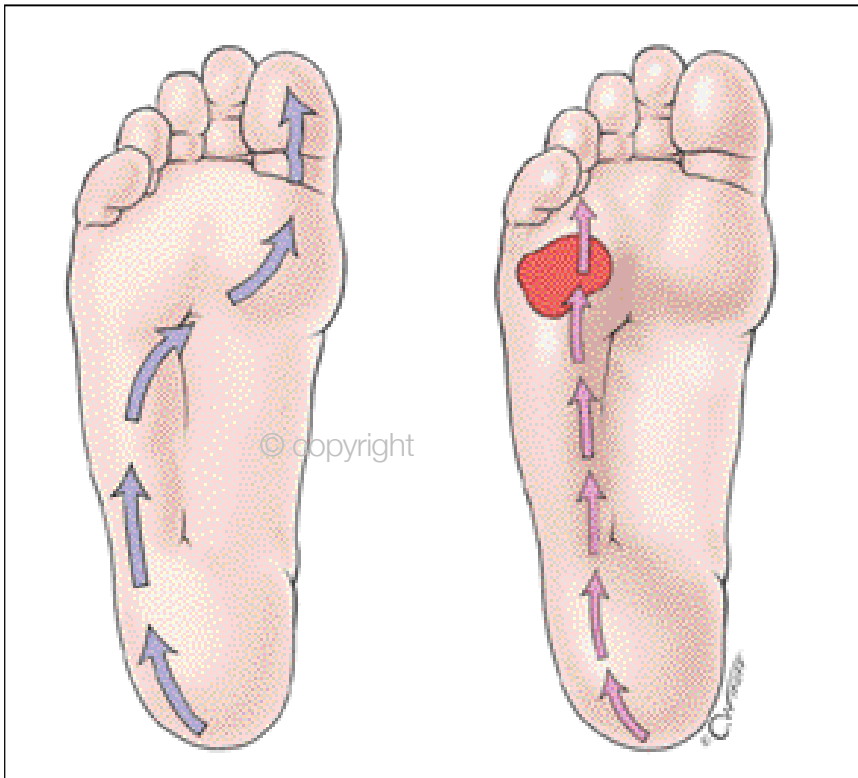


Figure 2. Force lines of a normal foot (stable loading; left) and Pam's foot (lateral loading; right). The inpointing and repetitive rolling and weakening of Pam's ankles produce force patterns similar to that of a high arched foot.

make her feet more comfortable and decrease pressure on her corns in the short term, but they don't support her feet. In the long term, pressure on her lateral forefoot and ankle instability will increase.

A podiatrist could advise Pam on appropriate corrective and supportive footwear, and a physiotherapist could suggest a program to increase ankle stability and knee extension.

Pam's corns can be treated, and she could be advised on how to keep the corn and thickened skin on her lateral soles under control (e.g. using a pumice stone after her shower and the liberal use of a moisturiser).

Improving Pam's footwear

Pam may have a normal foot shape but the inpointing and the repetitive rolling

and weakening of the ankle produce force patterns during walking similar to that of a high arched foot (Figure 2).

Orthotics would distribute the load more evenly over the foot. Heel raisers can be used to allow for limited ankle flexion until this limitation is corrected by a physiotherapy program.

Pam's footwear can be modified as the structural and functional ankle joint and calf and thigh muscle problems are corrected.

Reducing the risk of future foot problems

More appropriate shoes will help Pam, but the structural and functional problems need to be addressed. Pam should undertake an ankle rehabilitation program to increase her ankle strength, her sense of joint position, and the reflexes

that protect her ankles. She will also benefit from a 'stretching program' for her tight hamstring and calf muscles. Hydrotherapy sessions may be advised so she can exercise without straining her ankles.

Once her footwear, ankle and muscle problems are corrected, Pam's feet and gait may be normal enough to enable her to gradually increase her activity. She may then enter a 'virtuous cycle' (as opposed to the previous 'vicious' cycle) of increasing activity, increasing fitness and strength, decreasing weight and decreasing stress on her feet and ankles.

Walking more and weighing less will also improve Pam's glycaemic control, which was the reason her foot problems were discussed in the first place.

If, as occasionally occurs, these conservative measures do not make Pam's feet functional, she could be referred to an orthopaedic surgeon with a special interest in the lower limb for advice on surgery to reduce the femoral torsion causing her pigeon toes. MT

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Don's duck feet

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How would you assess this man's foot eversion, and what could you do to prevent his risk of future problems resulting from an expected build up of callus?

Case history

Don is 59-years-old and has recently been diagnosed with type 2 diabetes. He has all of the 'F words' for diabetes:

- he is over Forty years of age
- he has a Family history of diabetes; his sister also has type 2 diabetes
- he is Fat (weight 87.5 kg, height 1.75 m; BMI 28.6 kg/m²).

You have advised Don to 'eat less and walk more',¹ but he says he can't walk 10 minutes a day, let alone 30 minutes, because his feet hurt.

Don takes off his shoes and socks and shows you areas of callus on the medial side of the first metatarsal heads and great toes. These areas feel hot and become tender with walking.

Don has tried various types of 'bandaids' to shield these areas, but the bandaids often rub. He has also tried different shoes and finds soft shoes to be the most comfortable; however, even with soft shoes and if the bandaids are not rubbing, walking makes the arch area of his feet become sore and produces a burning pain on the medial aspect of his ankles and knees.

When Don stands and walks you notice that his feet are quite abducted (30 to 40°) and everted – just like duck feet, which he has always had. When you check his shoes you can see they have worn more on the medial heel and medial forefoot regions. Otherwise, Don has healthy feet with normal blood flow and sensation.

Questions to consider

- Why has Don developed duck feet?
- What factors relevant to Don's feet should you assess?
- How can Don's footwear and footcare be improved?
- What else can you and Don do to reduce his risk of future problems?

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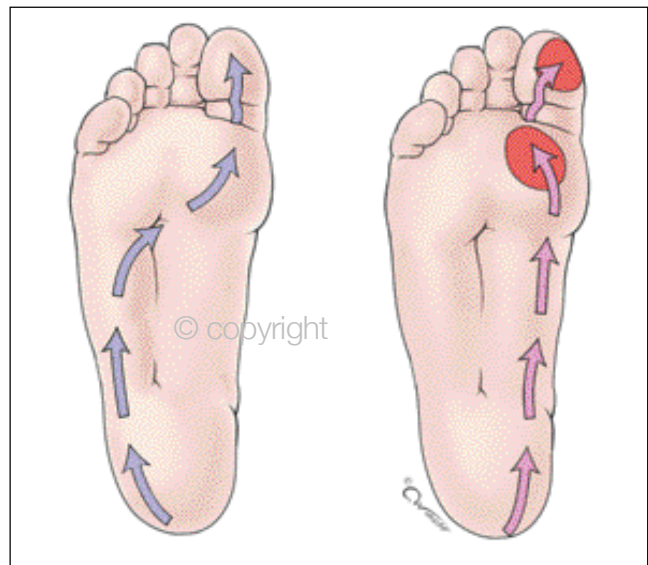


Figure 1. Load patterns of a normal foot (a) and a flat foot (b). The pattern of loading of duck feet is similar to that seen with flat feet.



Figure 2. A young person with both duck and flat feet. This combination is not uncommon and results in very high loads on the medial sole.

Why Don has duck feet

Don has abducted hips and lateral tibial torsion – his feet are at the end of very turned out legs.² This foot eversion means the medial side of the foot becomes disproportionately loaded while walking. This pattern of loading is similar to that seen with flat feet (Figure 1b); the combination of duck and flat feet is not uncommon and results in very high loads on the medial sole (Figure 2). Since the first metatarsal head and hallux try to 'push off' during the walking cycle, loads are very heavy there because the feet are so abducted. The skin thickens in compensation, forming callus and/or corns.

Factors relevant to Don's feet to assess

The factors that should be assessed during a foot structure check up are summarised in the Table. Assessment of these factors should reveal problems that Don's foot anatomy is causing.

Table. Summary of the foot structure check up

Factors	Feet	Footwear	Gait
Nonweight-bearing factors	<ul style="list-style-type: none"> Plantar calluses Dorsal pressure areas Arch shape 	<ul style="list-style-type: none"> Shape Sole 	Not applicable
Weight-bearing factors	<ul style="list-style-type: none"> Normal Flat: rolled in High arch: rolled out 	<ul style="list-style-type: none"> Do the feet lean in or out of shoes? Are there pressure areas over toe regions of the shoes? 	<ul style="list-style-type: none"> When the patient has bare feet, do the feet roll in or out, or stay straight? Do shoes change the barefoot gait pattern? Is this better or worse?

In the long term, soft tissues and muscles adapt to a skeletal abnormality. The internal rotators become weak and the balance between the muscles around the knee and the knee position change. The wear on the medial side of Don’s shoes has already been identified.

Improving Don’s footwear and footcare

Don probably likes a soft leather shoe that doesn’t rub the arch of his foot. Although this type of shoe is soft and pliable, it distorts more easily, increases pressure on the sole and won’t support his feet. Generally, shoes curve inward from heel to toe (i.e. they are slightly curved in). The normal foot distributes the load from heel strike to lateral midfoot to medial forefoot (see Figure 1a) and the structure of the shoe (the ‘last’) reflects this. But this sort of ‘last’ would not suit Don’s feet where loads fall medially. Don needs a straight lasted shoe with a firmer heel counter and flexible forefoot.³ Recommendation of this type of shoe would be the first step to take in improving Don’s footwear. Such footwear may provide enough support on its own, but if it doesn’t an orthotic might be needed to reinforce the effect of the shoe.

Reducing Don’s future problems

To reduce future foot problems, three areas should be addressed:

- the basic foot anatomy
- soft tissue and muscle adaptations that may be counter-productive
- problems correctible by footwear and footcare.

Don’s foot anatomy might be so extreme that a vigorous physiotherapy, podiatry and self-care program would not make his feet functional. If this was the case, an orthopaedic surgeon might be able to change his anatomically turned out legs and/or address the problem of overload of the medial compartment of his knee.⁴

A physiotherapist could suggest a program to strengthen

Don’s internal hip rotators and rebalance the forces around his knee.⁵ If Don were to have surgery, a physiotherapy program would be an important part of management.

Given Don’s leg alignment, some ongoing pressure over the hallux and first metatarsal heads is likely to remain despite everyone’s best efforts. Don needs a plan to manage the expected callus build up. He has healthy blood flow and sensation, normal vision and easy access to his feet, so regular gentle use of a pumice stone or equivalent abrasive would keep callus under control. It is important that the callus does not build up, as it will be painful and discourage exercise (while sensation is normal) or could cause a future ulcer (once sensation is lost). A podiatrist could show him how to keep control of the callus and also monitor his footwear and orthotics to make sure that they continue to meet the needs of his anatomy. MT

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Foot care FAQs

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Am I at risk of developing foot problems?

You might be at risk of developing foot problems, such as ulcers, because of your diabetes. Consider the following questions.

- **Do you have nerve damage?**
Are your feet numb, or do they feel like they are burning (particularly at night)? If they do, you may have nerve damage.
- **Is your blood circulation poor?**
When you walk, do you get a cramping pain in your calves or other muscles that goes away when you stop walking but comes back as soon as you start walking again? Is this pain worse when walking up hills, against the wind or on cold days? Have you had a heart attack or a stroke? If blood vessels in your heart or brain have been affected by having a heart attack or a stroke, the vessels in your legs may also be affected.
- **Are your feet showing signs of having too much pressure on them?**
Do you have spots of thick skin (callus or corn) or thick nails? Thickening of skin or nails occurs as your body's response to excess pressure, and occurs particularly if you have nerve damage in your feet.
- **Have you had a foot ulcer before?**

If you have had a foot ulcer before, you will certainly not want to have another one but you are at an increased risk of further ulcers or foot problems. If you answered yes to any of the above questions, you may be at risk of foot problems. Seek advice from your doctor, diabetes nurse or podiatrist.

What shoes and socks should I wear?

You should wear shoes and socks that protect your feet and make walking a pleasure, not a pain. If you are at risk of developing foot ulcers, you may need custom-made footwear and orthotics.

- **Do your shoes fit your feet?**
Check whether your shoes fit your feet properly. Do your feet have to fit your shoes, with your feet getting pressured and your shoes getting worn at particular spots? Check your feet and your shoes for excess wear and tear. When you buy new shoes, try them on while wearing the socks that you will usually wear with them. Also try on shoes after you have been on your feet for some time. Check that you can wiggle your toes freely and make sure that between your longest toe and the end of the shoe there is space equal to the width of your finger. The Figure above shows the features that you should look for when choosing a sports shoe.
- **Do your shoes protect you?**
Shoes should hold on to your foot and the ground you walk on. Do your feet slip around in your shoes, or your shoes slip on the surfaces you walk on? You may need

This handout outlines simple foot care routines for people who have diabetes.*

Consider the following frequently asked questions, and work out what applies to you.

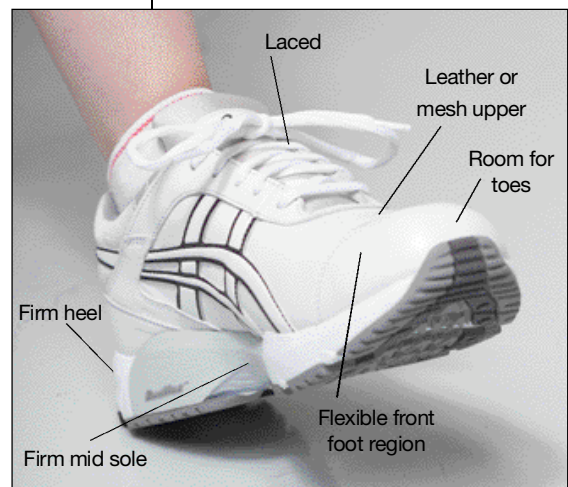
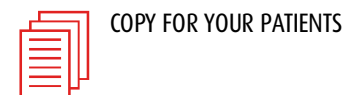


Figure. Features to look for when choosing a sports shoe.



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shoes with extra grip on your feet for walking on uneven ground, extra cushioning for walking on pebbly ground, or special soles for walking on slippery surfaces.

• **Do your shoes protect your feet?**

Footwear is supposed to protect your feet, not damage them. Do your shoes cover your feet? Are they strong enough to absorb the occasional knock? Have they got any rough areas on the insides of them? Do your socks have seams that rub on your feet?

• **Are your feet dry?**

Your shoes and socks should ‘breathe’. Your feet, socks and skin should not get soggy while wearing shoes. It is best to wear wool or cotton socks, which soak up the moisture, and shoes with leather uppers, which let the moisture out.

Who will look after my feet?

Remember you only have the one pair to last you your lifetime, so it is important to look after your feet. If you think you are unable to care for your feet, ask your doctor, diabetes nurse or podiatrist for advice on who can help. If you are at risk of developing foot complications, you should have your feet checked regularly by your doctor, diabetes nurse or podiatrist.

• **Can you reach, see and feel your feet yourself?**

If you can’t reach, see and feel your feet, you may need some help to care for them. Your partner or family may be willing and able to help. If not, seek professional help. Don’t muddle along on your own – it is too easy to damage your feet.

• **Are your skin or nails dry?**

If your skin or nails are dry, they may need extra care. Use a moisturiser (such as sorbolene with 10% glycerol) after your shower and before bed if necessary.

• **Are your nails in shape?**

Trim your nails using clean clippers and follow the natural curve of your toe. Don’t cut your nails too short. Never cut down the edges of the nail. File any sharp edges with a nail file or emery board.

• **Is there any ‘rubbish’ between your toes?**

Sogginess, dead skin, debris and tinea (a fungal infection) between your toes can lead to serious infections that can spread into your foot. Keep this area clean and dry. If necessary, use a little methylated spirits to dry the area.

• **Have you got an action plan for when things go wrong?**

This is particularly important if you are at high risk of developing foot problems. Make yourself a foot care kit containing the items listed in the Table above. If you do damage or break the skin, gently wash and dry the foot, apply an antiseptic (such as povidone–iodine [Betadine]) and a nonstick dressing, and secure this in place with a nonplastic tape. Check the area and reapply a new dressing daily. If any redness or swelling occurs, or if things aren’t improving in a day or so, make sure you visit your doctor.

Remember the four ‘bottom lines’

- Check your risk of developing a foot ulcer.
- Make sure your footwear protects your feet.
- Set up a schedule to care for your feet.
- Seek advice as soon as possible from your doctor, diabetes nurse or podiatrist if swelling, redness or a skin ulcer develops on your feet.

MT

Table. What to put in your foot care kit

- Povidone–iodine solution or ointment (e.g. Betadine)
- Moisturising cream (e.g. sorbolene with 10% glycerol)
- Dry dressing (e.g. Handypor)
- Sterile gauze squares
- Cotton buds
- Nail clippers
- Nail file or emery board

Note: Seek advice as soon as possible from your doctor, diabetes nurse or podiatrist if swelling, redness or a skin ulcer develops on your feet.



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