

Avoiding foot complications in diabetes

Foot complications in diabetes are serious and costly.

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Foot complications are among the most serious and costly complications of diabetes mellitus, with ulceration increasing worldwide and over 80% of foot and lower limb amputations being preceded by a foot ulcer.^{1,2} Every 30 seconds a lower limb or part of a lower limb is lost somewhere in the world as a consequence of diabetes. Up to 70% of people who undergo a lower extremity amputation die within 5 years.¹ Worldwide in 2003 there were 194 million people between the ages 20 -79 with diabetes; currently the estimate is that among adults the prevalence of diabetes is expected to reach 333 million by 2025.^{1,2}

Looking at the feet of people with diabetes, recognising problems and acting on them quickly is the key to success for patients and health care practitioners.

Looking at the feet of people with diabetes, recognising problems and acting on them quickly is the key to success for patients and health care practitioners.³ The International Diabetes Federation (IDF) together with the International Working Group on the Diabetic Foot (IWGDF) issued a call to action in 2005 in which they highlighted the scope of the problem of diabetes as the global epidemic of the 21st century.²

Data on diabetic foot complications in South Africa are sparse. However, as diabetes and diabetic foot complications, especially amputations, increase worldwide, there is no reason to believe that South Africa is any different, given our health resources. This is particularly evident in the scarcity of co-ordinated foot care and podiatry. Recognising the problem of foot complications, the Society for Endocrinology, Metabolism and Diabetes of South Africa (SEMDSA) has published Diabetes Foot Care Guidelines for Primary Healthcare Providers, modelled on those published by the IWGDF.⁴ The Diabetic Foot Working Group (DFWG), a multidisciplinary organisation, was formed in 2007, with the aim of improving foot care for people with diabetes in South Africa.⁵

Diabetic foot complications are aggravated by the underlying pathophysiology, which creates the pathways to ulceration. The four most important factors in the development of foot ulcers are peripheral neuropathy, deformity, peripheral vascular disease and injury.^{1,2} The pathways to diabetic foot ulcerations are shown in Fig. 1.

Clinically ischaemia without neuropathy is rare.

Singly, or as is more usual, in combination, these factors lead to alterations in foot shape, gait patterns, postural stability and joint mobility. The loss of the protective sensory mechanisms relating to pain, heat, cold, pressure and proprioception allows increased callus formation at pressure points. This usually precedes an ulcer. Autonomic neuropathy causes a warm foot with bulging veins and dry cracked skin, allowing a portal of entry for bacteria. Poor vascular nutrition makes skin and soft tissues susceptible to damage from footwear with an increased potential for delayed healing.

Motor neuropathy is responsible for the muscle wasting and weakness which causes alterations in foot shape, foot biomechanics and gait. Repetitive stresses cause hyperkeratosis, followed by subcutaneous haemorrhage, skin breakdown and ulceration. If this is not recognised early, the end result can be osteomyelitis and possibly amputation.

Peripheral vascular disease is usually characterised by pain, as narrowing of the lower limb and foot arteries results in poor supply of nutrients and oxygen. The soft tissues and muscles are slowly starved and begin to waste. When a leg artery becomes blocked or severely narrowed, patients exhibit a cold and painful limb, typically described as ischaemia.^{3,9} However, clinically ischaemia without neuropathy is rare.³

Typical foot complications include:

- absent pulses
- cold foot
- bright pink colour, pallor or bluish discoloration
- atrophic skin and nails
- nail conditions
- blisters
- dry skin and fissures
- increased and painless callus
- dermal fissures
- fungal infections
- deformity and prominences such as claw toes, pes cavus and hallux valgus
- injury by foreign objects (barefoot or in shoes)

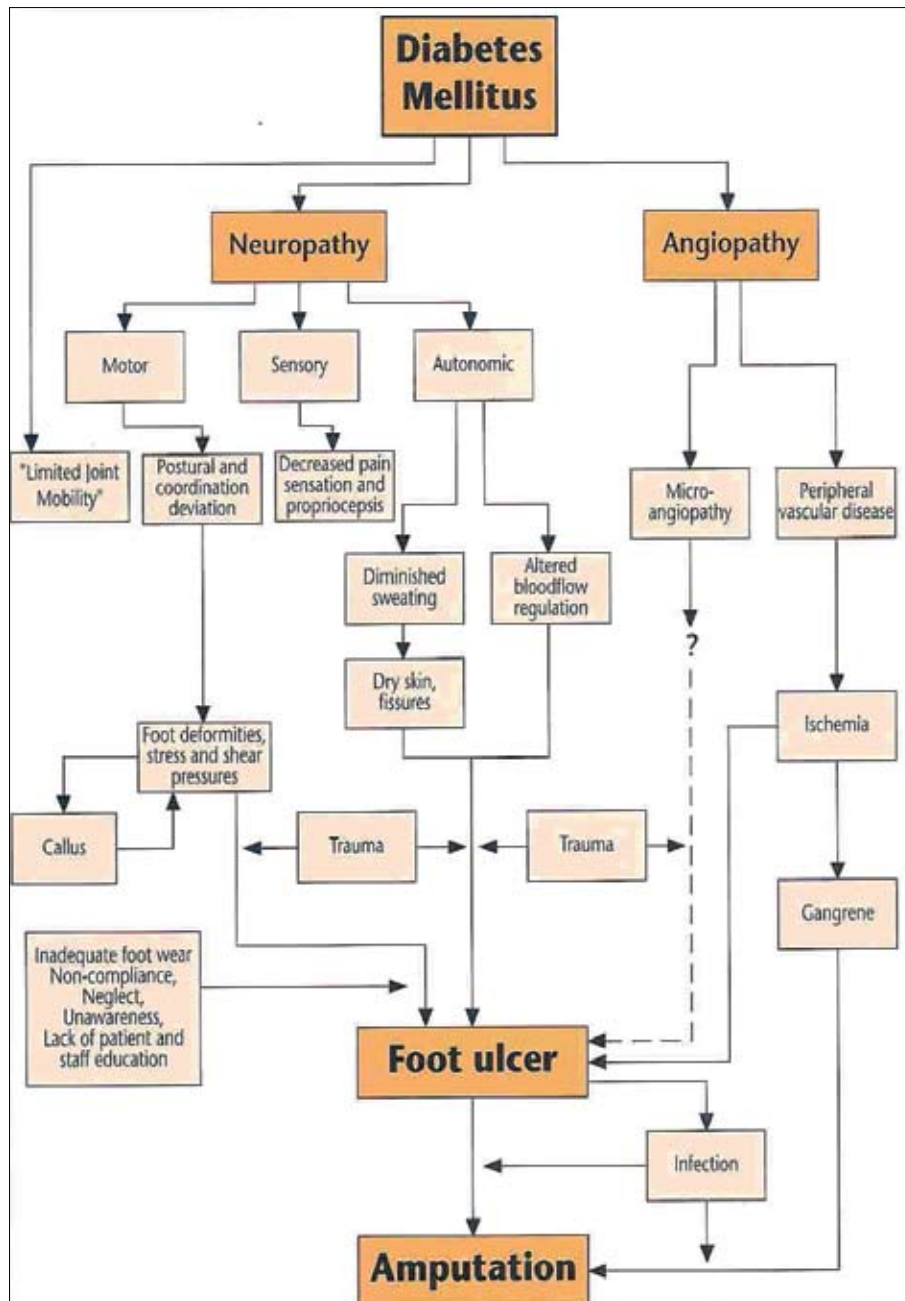


Fig. 1. Pathways to diabetic foot ulceration.

- burns and scalds
- ulceration, especially plantar (usually neuropathic)
- cellulitis and soft-tissue infection
- osteomyelitis
- gangrene, wet or dry
- neuropathic oedema
- osteoporosis
- pathological fractures
- Charcot's neuroarthropathy.

Figs 2 - 4 illustrate some of the conditions.

Many problems develop by accident, but frequently they are caused by poor self-care, neglect or lack of knowledge. It is also well documented that poor socio-economic conditions have a negative effect

on patients' ability to manage a problem foot.¹ Age, male gender and duration of diabetes are also factors.³ In South Africa, this is compounded by lack of easy access to appropriate care, which can result in the wrong person, albeit with the right idea, having to provide care. Also there are few education programmes and therefore inadequate individual or family awareness of a patient's foot risk status.

Another factor that is being increasingly recognised is the impact of psychological and behavioural issues on the diabetic foot. This could explain why some patients get repeat ulceration or fail to prevent ulceration in spite of being warned of their risk for ulceration. These changes to a patient's cognitive abilities appear to influence their ability to comprehend and therefore can reduce the effectiveness of foot health education.^{3,6}



Fig. 2. Injury: cutting nail.



Fig. 3. Callus with early ulcer.



Fig. 4. Neuropathic ulcer.

In recognition of these various factors, there is international agreement and evidence that the most successful way to avoid foot complications in diabetes is by screening and regular foot examination.^{1-4,7} There is less consensus on who should perform the examination. It can be performed by anyone who has been correctly trained and who has the basic equipment. The point to remember is that the purpose of the examination is to establish a level of risk for complications – the foot risk status – and act accordingly.^{1-3,9} This examination, as part of another well-proven strategy – multidisciplinary team management of diabetes – has been shown

to reduce amputations by 49 - 85%.^{1,3} Evidence from Brazil shows that investing in a diabetic foot care programme can be one of the most cost-effective forms of health care expenditure, provided the programme is goal focused and properly implemented.^{1,2} Given the high cost of ulcers to individuals, health care systems and societies in general, the relatively low-cost interventions of preventive foot care are likely to be cost-effective or even cost-saving.¹

The IWGDF has identified five key elements as the cornerstones of foot management:¹

- Regular inspection and examination of the at-risk foot
- Identification of the at-risk foot
- Education for patients, family and health care providers
- Appropriate footwear
- Treatment of non-ulcerative pathology.

As a first step in attempting to avoid diabetic foot complications health care practitioners must accept the principle of the multidisciplinary team approach as the only way to have any chance of success. The IWGDF suggests that three levels of foot-care management are needed (Table I).

The key to the multidisciplinary approach is a basic examination to identify risk, followed by an advanced examination to stage the foot. Finally, based on these findings specific management can be planned and implemented.^{1,3}

The aims of the basic foot examination are:

- to detect the presence of significant problems
- to ensure that the patient understands footcare and footwear
- to make appropriate referral.

Following the initial risk status or basic examination, the high-risk patient is referred for an advanced assessment, which is performed with the following aims:

- to assess the current state of foot health in more detail
- to review the current treatment programme to ensure that it is optimal
- to act on findings.

The advanced examination is ideally performed by a podiatrist as part of a multidisciplinary team or at least with access to the appropriate members of the team. It comprises three sections:

- classification
- staging
- taking control.

Classification is essential to identify the neuropathic or neuroischaemic foot, remembering that ischaemia without neuropathy is rare, and enables the podiatrist to decide on treatment, referrals and follow-up. It helps to identify the type of neuropathy, the complications of the neuropathic foot and the signs and symptoms of ischaemia. After classification, the natural history of the diabetic foot can be divided into individual stages (Table II).^{3,8,9}

There is international agreement and evidence that the most successful way to avoid foot complications in diabetes is by screening and regular foot examination.

After correctly classifying and staging the diabetic foot, the findings are used as a framework for selecting a management programme for the patient. There are six different aspects of management and taking control: mechanical, metabolic, microbiological, vascular, wound and educational.

Having gathered all this information the final part of the advanced examination

is to decide which aspect of control is needed for each individual patient. This is the ultimate activity of multidisciplinary team management.^{3,8,9}

This comprehensive approach works in developed countries and in the private sector in South Africa, where some patients have access to comprehensive managed care, through the Centre for Diabetes and Endocrinology, or podiatrists with a special interest in diabetes. In the wider South African context, access to care from limited resources remains a problem. For many patients it is not easy or possible to return for repeat or follow-up assessments. Therefore the focus must be to ensure that at the very least, every person with diabetes has their feet examined annually. In addition, those who are identified as high risk can be referred for whatever appropriate further assessment is available.

A locally developed Foot Assessment Sheet, based on the IWGDF criteria, is recommended (Fig. 5). The basic diagnostic equipment required for this examination includes a 10 g Semmes-Weinstein monofilament and a 128 Hz tuning fork. There is some discussion about the selection of monofilaments since they are expensive and various cheaper versions exist. However, the consequences of inaccurate or faulty monofilaments, for both patients and health services, are greater than might at first be imagined.¹⁰

Providing education on foot care for people with diabetes in South Africa presents unique challenges, due to the diversity of language and literacy levels of patients. This diversity creates an opportunity to ensure that education is tailored and directed. This could avoid the problem of education being poorly done or based on the 'one-size fits all' principle. Best practice and current evidence says

Table I. Levels of foot-care management (modified from IWGDF)

Level	Multidisciplinary team members
1	General practitioner, podiatrist and diabetic nurse
2	Diabetologist, surgeon (general and/or vascular and/or orthopaedic), podiatrist and diabetic nurse
3	Specialised foot centre with multiple disciplines specialised in diabetic foot care

Table II. Staging of diabetic foot (modified from Foster)

Stage	Foot status
1	Normal foot with no neuropathy and no ischaemia
2	High-risk foot: neuropathy or neuroischaemia is present
3	Ulcerated foot with tissue breakdown: cuts, fissures, blisters, burns, ulcers present
4	Infected foot: signs of infection and cellulitis
5	Necrotic or gangrenous foot
6	Unsalvageable foot: major amputation is inevitable

Nr:

Year DM diagnosed:

DM treatment: Diet only / Oral agents / Insulin / Oral agents + insulin

The foot is at risk if any of the below are present in either of the 2 feet

Deformity or bony prominences	Yes / No
Skin not intact (ulcer)	Yes / No
Neuropathy	
- Monofilament undetectable (>1/3 any spot)	Yes / No
- Tuning fork undetectable (>1/3)	Yes / No
Callus	Yes / No
Foot pulses	
- Tibial posterior artery absent	Yes / No
- Dorsal pedal artery absent	Yes / No
Any others	
- previous ulcer	Yes / No
- amputation	Yes / No
Inappropriate footwear	Yes / No
Risk Category	(Tick appropriate box)
Low Risk Patient None of the five high risk characteristics below.	Yes / No
High Risk Patient One or more of the following: Loss of protective sensation, Both pedal pulses absent any foot, Foot deformity, History of foot ulcer, Prior amputation	Yes / No
Referral (any foot with neuropathy, both pedal pulses absent, current or previous ulcer, gangrene or prior amputation)	Yes / No
Education given (any high risk foot)	Yes/ No

Fig. 5. Foot assessment sheet. (With acknowledgments to Prof. P Rheeder, University of Pretoria.)

this approach does not work.^{1-3,11} There is a plethora of foot health education material available in South Africa. Practitioners are urged to select what is most appropriate for their patients.

It is also well documented that poor socio-economic conditions have a negative effect on patients' ability to manage a problem foot.

The comment was once made, 'you cannot put the abnormal foot into a normal shoe', and people with diabetes are always advised to avoid walking barefoot. While the patient who is not at risk will usually be able to wear any shoe, the at-risk patient requires at the very least footwear with thicker, cushioning soles and possibly extra depth.^{1-3,12} It is more likely that they will require therapeutic or even custom-made footwear. Unfortunately there is little

evidence of the efficacy of the latter, but there is evidence of patient dissatisfaction with this type of footwear.^{12,13} With reference to warmer climates (and also to the developing world), attention must be paid to correctly fitting sandals and the avoidance of skin irritation.¹⁴

Callus, nail and skin pathologies and underlying biomechanical causes should be treated regularly by a trained foot care specialist, preferably a podiatrist. Foot deformities should be treated non-surgically, for example with prescription foot orthoses. The reduction of callus reduces local foot pressures and therefore the risk of ulceration.^{9,15,16}

References

1. International Working Group on the Diabetic Foot/Consultative Section of the IDF. Amsterdam, the Netherlands, on DVD (www.idf.org/bookshop)
2. Bakker K, Foster AVM, van Houtum WH, Riley PC. *Diabetes and Foot Care: Time to Act*. Brussels: International Diabetes Federation, 2005.
3. Foster AVM. *Podiatric Assessment and Management of the Diabetic Foot*. London: Churchill Livingstone, Elsevier, 2006.
4. <http://www.semDSA.org.za/guidelines>
5. <http://www.dfwg.co.za> (Accessed 10 Jan 2010).
6. Vileikyte L. Psychological and behavioural issues in diabetic foot ulceration. In: Boulton AJM, Cavanagh PR, Rayman G, eds. *The Foot in Diabetes*, 4th ed. Chichester: John Wiley 2006; 132-142.
7. Peters E. Screening for the diabetic foot: how and why. *Diabetes Voice* 2005; 50 (Special issue): 25-27.
8. Johnson T. Managing the foot of a person with diabetes. *SA Journal of Diabetes* 2009; 2(3): 25-30.
9. Edmonds ME, Foster AVM, Sanders LJ. *A Practical Manual of Diabetic Foot Care*. London: Blackwell, 2004.
10. Young M. A perfect 10? Why the accuracy of your monofilament matters. *Diabetic Foot Journal* 2008; 11(3): 106-111.
11. McGill M. Foot-care education for people with diabetes: a major challenge. *Diabetes Voice* 2005; 50 (Special issue): 36-39.
12. Cavanagh PR, Ulbrecht JS. Footwear for people with diabetes. In: Boulton AJM, Cavanagh PR, Rayman G, eds. *The Foot in Diabetes*, 4th ed. Chichester: John Wiley 2006; 346.
13. Emery M, Borthwick A. The orthopaedic footwear service: a survey of effectiveness. *The Diabetic Foot* 2002; 5(1): 45-50.
14. Tulley S. Appropriate footwear: sandals or shoes? *Diabetes Voice* 2005; 50 (Special issue): 35.
15. Johnson T. Common skin and nail pathologies of the foot – considerations for the patient with diabetes. *SA Journal of Diabetes* 2009; 2(4): 21-29.
16. Clarke EAM. Cause for concern: the pathology of the non-ulcerative foot. *Diabetes Voice* 2005; 50 (Special issue): 22-24.

In a nutshell

- Every patient with diabetes should have a basic foot screening examination annually to establish their risk status.
- People at high risk should be referred for a more detailed and frequent examination to enable directed management.
- A multidisciplinary approach to management of the feet of people with diabetes has proven success.
- Social isolation, poor education and low socio-economic status place people with diabetes at higher risk of foot problems.
- Education should be simple, individualised and targeted at health care providers as well as people with diabetes and their families.
- Appropriate footwear such as thicker soled trainers must be used indoors and outdoors.
- Non-ulcerative pathologies must be regularly and correctly treated.
- Investing in a diabetic foot care programme can be a cost effective health care strategy.