

DIABETIC FOOT ULCERS: WHAT IS BEST PRACTICE IN THE UK?

Numerous clinical guidelines have been published to disseminate evidence-based practice, standardise care for individuals with diabetes and inform practitioners on current best practice. Through the exploration of current evidence, this article will revisit 10 key themes identified by McIntosh and Newton (2006) to help practitioners adopt a systematic approach to the assessment and management of diabetic foot problems.

Caroline McIntosh is a Senior Lecturer in Podiatry, University of Huddersfield

New international and national clinical guidelines have been published since the author's review article featured in the last edition of *Wound Essentials* (McIntosh and Newton, 2006). While regular publication of current evidence is crucial to promote best practice, it can be difficult for clinicians, particularly non-specialists, to stay abreast of current developments in diabetes foot care.

Diabetic foot disorders, such as ulceration (*Figure 1*), infection, gangrene and amputation, associated with the chronic complications of diabetes are a major source of morbidity and a leading cause of hospital admission for people with diabetes (Frykberg et al, 2006). Despite advances in knowledge and treatments, as many as 12–25% of people with diabetes will develop foot ulceration at some stage of their disease (Cavanagh et al, 2005; Singh et al, 2005), many of whom will require amputation. Statistics suggest a limb is lost to diabetes every 30 seconds somewhere in the world (International Diabetes Federation [IDF], 2005). This is alarming, given that ulceration and amputations



Figure 1. Diabetic foot ulcer.

are not inevitable. Amputation risk can be decreased by between 49–85% via the implementation of appropriate care strategies, including a multidisciplinary team approach, close monitoring, patient education and education for healthcare professionals involved in diabetic foot care (IDF, 2005).

Clinical guidelines

Clinical guidelines aim to offer clinical guidance, disseminate best practice based on evidence and standardise patient care. The last decade has seen the development and publication of

a number of clinical guidelines, from various organisations, that specifically focus on diabetic foot disorders, namely: the *International Consensus on the Diabetic Foot* (The International Working Group on the Diabetic Foot, 1999); *The Management of Diabetes: A National Clinical Guide* (Scottish Intercollegiate Guidelines Network [SIGN], 2001); *National Service Framework [NSF] for Diabetes* (Department of Health [DoH], 2001) and *Clinical Guidelines for Type 2 Diabetes: Prevention and Management of Foot*

Problems, Clinical Guideline 10 (the National Institute of Clinical Excellence [NICE], 2004). New evidence for the assessment and management of diabetic foot disorders is constantly emerging. This has led to the publication of two recent international and national guidelines; The IDF has published global guidelines for type 2 diabetes (IDF, 2005) and a joint collaboration from Foot in Diabetes UK (FDUK), Diabetes UK, The Association of British Diabetologists, The Primary Care Diabetes Society and The Society of Chiropodists and Podiatrists (2006) has resulted in the publication of the *National Minimum Clinical Skills Framework for Commissioning of Foot Care Services for People with Diabetes*.

Assessing the diabetic foot

All individuals with diabetes should receive regular screening to identify their risk of developing foot problems. NICE (2004) advise basic foot examinations should be undertaken by appropriately trained personnel, and this might include podiatrists, nurses, doctors or healthcare assistants depending on local policy. The FDUK and associates (2006) highlight the fact that assessment might be undertaken by a healthcare professional with limited specialist knowledge. They suggest those involved in assessing the diabetic foot should, as a minimum, be able to: identify sensory loss (neuropathy); recognise when arterial blood supply to the foot is compromised (peripheral arterial disease); identify foot deformities and other factors such as poor control of blood glucose and poor self-care that increase the risk of foot problems including ulceration.

Basic foot examination

The IDF (2006) recommends that basic foot examination should include:

- ▶▶ Establishing whether there is a history of previous ulceration or amputation
- ▶▶ Identifying whether there is a visual or physical difficulty that prevents appropriate self-care
- ▶▶ Palpation of foot pulses — dorsalis pedis and posterior tibial pulses, capillary refill testing and ankle:brachial pressure indices if pulses are diminished
- ▶▶ Testing for sensory loss with a 10 gram monofilament or a 128Hz tuning fork
- ▶▶ Inspection of the feet for deformities (hammer toes, clawed toes or bony prominences), toenail deformities/pathology and skin pathologies, such as callus and corn.

Identifying risk status

Evidence supports regular foot screening for all patients

with diabetes to identify those at risk of foot ulceration and amputation (Singh et al, 2005). Early identification of risk factors allows practitioners to instigate prompt evidence-based strategies to prevent and manage diabetic foot problems. *Table 1* lists recognised risk factors for diabetic foot problems.

Risk classification

Following a basic foot examination, the patient can be classified according to their risk status. The International Consensus on the Diabetic Foot (1999) introduced a simple classification system for identifying the foot at risk (*Table 2*). This system has been adapted for use in other published guidelines (NICE, 2004; Frykberg et al, 2006).

Risk classification is a useful tool to inform management strategies, such as frequency of review, and to prevent foot problems occurring.

Table 1

Risk factors for diabetic foot problems

Peripheral neuropathy (nerve dysfunction)	Sensory loss is recognised as a major cause of diabetic foot ulceration. It is estimated that 45–60% of all diabetic ulcerations are due to peripheral neuropathy, particularly sensory neuropathy (loss of feeling) (Frykberg et al, 2006)
Peripheral arterial disease/ischaemia	Poor blood supply to the foot (ischaemia) is another significant risk factor for diabetic foot ulceration, which often occurs in combination with loss of sensation. An estimated 45% of diabetic ulcers are due to ischaemia and neuropathy (Frykberg et al, 2006) and are termed neuroischaemic ulcers
Poor glycaemic control	High blood glucose levels can increase the risk of complications arising. It is well-established that high glucose levels increase the risk of vascular disease (United Kingdom Prospective Diabetes Study [UKPDS], 1998) but they can also give rise to neuropathy and increase infection risk (Falanga, 2005)
Foot deformities	Foot deformity is recognised as a risk factor for diabetic foot ulceration. IDF (2005) recommends regular assessment of foot deformities; hammer or clawed toes and bony prominences could be subject to high pressure and trauma, particularly in the presence of sensory loss

Table 2

Risk classification for the diabetic foot

Risk status	Clinical findings	Clinical review
Risk 1 Low risk	<ul style="list-style-type: none"> • No increased risk of foot problems • No signs of peripheral neuropathy • No peripheral vascular disease • No foot deformity 	Annual review
Risk 2 Medium risk	<ul style="list-style-type: none"> • Peripheral vascular disease and/or peripheral neuropathy • Impaired sensation • Foot deformities 	Every 3–6 months
Risk 3 High risk	<ul style="list-style-type: none"> • Peripheral neuropathy • Peripheral vascular disease • History of previous foot ulcers or amputation • Charcot changes 	Every 1–3 months
Risk 4 Acute foot problems	<ul style="list-style-type: none"> • Acute foot problems, e.g. ulceration • Ischaemia • Infection • Acute charcot foot 	Every 1–7 days dependent on need

(adapted from the International Consensus on the Diabetic Foot, 1999; Frykberg et al, 2006)

FDUK and associates (2006) stress the importance of ensuring that healthcare professionals involved in assessing and classifying risk status are sufficiently aware of when to refer for expert opinion and advice. This includes all new episodes of foot ulceration, swelling or inflammation of the foot, unexplained pain or any other problem that causes concern.

Prevention of foot problems

Prevention of diabetic foot ulceration should be the primary goal for all involved in diabetic foot care. Frykberg et al (2006) suggest this is best accomplished by a number of strategies:

1. A multidisciplinary team (MDT) approach to the management of diabetes and foot health. The team might include diabetologists, GPs, nurses, podiatrists, dieticians and orthotists, dependent on local policy.

2. Patient and family education.
3. Regular podiatry treatment, including debridement of callus and management of pathological toenails.
4. Healthcare provider education to ensure appropriate screening and recognition of risk factors for ulceration.

Managing diabetic foot ulcers

When a patient presents with a diabetic foot ulcer, NICE (2004) recommend referral to a specialist MDT within 24 hours. The team would be expected to undertake a comprehensive assessment and develop a management plan based on best evidence, but also tailored to meet the needs of the patient.

The following section will revisit 10 key areas, as highlighted in *Figure 2*, which must be addressed to achieve effective management of diabetic foot ulcers.

1. Advocate tight glycaemic control

It is well-established that high blood glucose levels can increase the risk of diabetes-related complications, specifically arterial disease (UKPDS, 1998), neuropathy and increased risk of infection. Furthermore, high blood glucose levels can impair wound healing in established foot ulcers (Falanga, 2005). Striving to achieve tight glycaemic control is crucial in the prevention and management of diabetic foot ulcers.

The IDF (2005) global guidelines advise people with diabetes to maintain blood glucose levels, as measured by the HbA_{1c} test, below 6.5%. The HbA_{1c} test provides a measure of glycosylated haemoglobin in the blood over a period of time, and should be carried out at 2–6-monthly intervals (McIntosh et al, 2001).

2. Identify aetiological factors

Initial assessment should enable practitioners to identify factors that have directly caused the foot ulcer, for example, ill-fitting footwear. Additionally, factors that have contributed to the ulceration and can contribute to a delay in healing should be identified, for example, peripheral neuropathy and peripheral arterial disease.

Management and prognosis differs significantly for ulcers caused by sensory loss (neuropathic ulcers) compared to those due to sensory loss combined with poor circulation (neuroischaemic ulcers) (Zimny, et al, 2002), therefore correct identification of aetiological factors is essential from the outset.

3. Establish and quantify vascular status

It is essential to determine the vascular status of the foot; findings will largely influence ulcer management, determine the likelihood of wound healing and identify the need for revascularisation. Basic foot examination should include assessment of vascular supply to the foot. NICE (2004), the IDF (2005) and Frykberg et al (2006) recommend:

- ▶▶ Palpation of foot pulses — palpation of dorsalis pedis and posterior tibial pulses should be undertaken
- ▶▶ If pulses are not palpable or arterial disease is suspected, other tests such as Doppler examination and ankle: brachial pressure index (ABPI) should be undertaken
- ▶▶ Capillary refill time. This can be a useful indicator of arterial perfusion to the toes. The test involves elevating the patient's leg slightly, and then using your thumb applying light pressure to the apex of the toe for a second or so until the skin is blanched. Then release the pressure and time in seconds how long it takes the skin to return to its normal colour. Normally capillary refill times are around 2–3 seconds in warm weather and 4–5 seconds in cold weather.
- ▶▶ Determining whether the patient is experiencing vascular symptoms, for example, intermittent claudication (i.e. pain in the calves on walking)
- ▶▶ Assessing the legs and feet for signs of arterial disease, for example, pale skin particularly on elevation
- ▶▶ If there is concern of significant peripheral arterial disease,

expert advice from the vascular team should be sought.

4. Manage arterial risk factors

Certain factors are known to increase the risk of arterial disease, for example, high blood pressure and high cholesterol. These factors should be identified and a team approach adopted to introduce management strategies that aim to minimise arterial complications.

The IDF (2005) recommend target blood pressure measurement below 130/80mmHg, which might be achieved by a combination of drugs and lifestyle modification or lifestyle modification alone. Modifiable factors that can help here include reduced salt and

alcohol intake, weight loss and increased activity.

Dyslipidaemia (abnormal lipid levels in the blood) and smoking can also increase the risk of arterial disease. Again, lifestyle changes such as weight loss, positive dietary changes, increased physical activity and smoking cessation should be encouraged (IDF, 2005).

5. Rapid management of infection

A large proportion of patients with diabetic foot ulceration will develop infection, including osteomyelitis (bone infection) and gangrene (O'Meara et al, 2006). Infection in the diabetic foot can spread rapidly, leading to tissue destruction and amputation (Edmonds, 2005). Early identification and prompt



Figure 2. Ten key elements in effective management of diabetic foot ulceration.

management of infection is crucial to prevent limb loss.

Recognising infection in the diabetic foot is often difficult; up to 50% of patients with infected diabetic foot ulcers will not show classic signs of infection (Edmonds and Foster, 2006). This is due to a poor blood supply that reduces inflammation, redness and heat, and neuropathy can mask pain. Practitioners must therefore be aware of other, often more subtle signs of infection. Cutting et al (2005) produced criteria for recognising clinical signs of infection in the diabetic foot, and some of these criteria are incorporated into a checklist for recognising infection in diabetic foot ulcers (Figure 3).

Frykberg et al (2006) advise all diabetic foot infections should be monitored closely. Management

will depend on severity of infection. Non-limb-threatening infection can be managed on an out-patient basis with broad spectrum antibiotics initially, followed by antibiotics tailored to swab results on review.

Individuals with limb-threatening infection require hospital admission for intravenous antibiotic treatment and possibly surgical debridement (Edmonds, 2005).

6. Identify wound characteristics

The TIME acronym for assessing the wound bed is now a well-established clinical tool (Figure 4).

Tissue: Removal of dead or devitalised tissue is paramount for effective wound bed preparation. Frykberg et al (2006) advocate regular debridement to remove necrotic tissue and reduce bacterial

burden in order to expedite wound healing. Sharp debridement by a skilled practitioner is probably the most frequently used method for removing dead or devitalised tissue on the diabetic foot. However, in some cases, for example in the presence of ischaemia, sharp debridement may be inappropriate and other types of debridement should be considered.

Emerging evidence suggests other forms of wound debridement such as topical negative pressure (TNP) therapy and larval therapy are advantageous for diabetic foot ulcers. Armstrong and Lavery (2005) undertook a large study, to investigate whether TNP therapy improves healing after partial amputation in patients with diabetes. Findings demonstrate that more patients in the TNP group healed, and at a quicker rate than those offered standard care.

Inflammation or infection: prompt recognition and management of infection is vital for wound healing; refer to key point 5.

Moisture imbalance: a moist wound environment is known to encourage healing by promoting granulation and encouraging autolytic debridement (the body's own form of wound debridement) (Frykberg et al, 2006). However, moisture balance must be maintained to prevent the wound bed becoming too dry or too moist, both of which could contribute to a delay in wound healing. Dressing selection should ensure moisture balance and create an optimum environment for healing.

Epithelium advancing or undermining: wound edges and surrounding skin should be examined for the

Identifying infection in diabetic foot ulcers	
1. Clinical signs of infection:	2. Systemic signs of infection:
Cellulitis*	Nausea
Lymphangitis*	Fatigue
Phlegmon*	Vomiting
Purulent exudate*	Fever
Pus/abscess	Chills
Crepitus in the joint*	3. Probe to bone test:
Erythema*	Bone palpated
Increase in exudate volume	No bone involvement
Localised pain	X-Ray required
Malodour	4. Wound culture:
Probes to bone*	Wound swab required
	Wound biopsy required

* see glossary of terms

Figure 3. Checklist for identifying infection in diabetic foot ulcers. Adapted from Cutting et al, 2005; Edmonds, 2005.

T	Tissue viable or non-viable
I	Infection or inflammation
M	Moisture balance
E	Epithelium advancing or undermining

Figure 4. TIME to Heal. Adapted from Watret, 2005.

presence of non-viable tissue such as callus. Watret (2005) stresses the importance of regular callus debridement by a skilled podiatrist in the healing of diabetic foot ulcers.

7. Establish and quantify neurological complications and pain

Peripheral neuropathy is a well-known risk factor for diabetic foot problems; as many as 45–60% of all diabetic ulcerations are purely neuropathic, while approximately 45% are neuroischaemic (Frykberg et al, 2006). Neurological status must therefore be established by the use of a monofilament to test for light touch and vibration perception testing, with a tuning fork or neurothesiometer. The presentation of peripheral neuropathy can vary from painless to painful. Patients with painful diabetic neuropathy may benefit from drugs such as amitriptyline hydrochloride (a tricyclic antidepressant), which have been shown to reduce symptoms (SIGN, 2001).

8. Employ offloading strategies

Pressure reduction or offloading is a key aspect of any plan aimed at preventing and healing diabetic foot ulcers. Offloading the ulcer site prevents further trauma and facilitates wound healing, and this is particularly important if the patient has sensory neuropathy (Frykberg et al, 2006). There are numerous

modalities available to offload diabetic foot ulcers and choice will be dependent on a number of factors: patient preference, ability to comply, severity of the ulcer and available resources.

9. Engage multidisciplinary team approach

Frykberg et al (2006) advocate a team approach to the prevention and management of diabetic foot problems, including non-specialist and specialist practitioners providing coordinated care. The benefits of multidisciplinary working in diabetic foot care are well-established (Edmonds et al, 1986); hence clinical guidelines advocate a team approach to diabetic foot care (International Working Group on the Diabetic Foot, 1999; NICE, 2004; IDF, 2005).

10. Offer structured education and empowerment

Structured education is an essential component of every patient care plan.

Both the IDF (2005) and FDUK and associates (2006) advise that practitioners should explain the reason for foot screening and discuss with the patient their individual level of risk. This will promote patient-centred care and, through negotiation, plans for future surveillance can be agreed.

Additionally, FDUK and associates (2006) recommend that healthcare professionals involved in diabetic foot care should, as a minimum:

- ▶▶ Recognise the need for and initiate appropriate referrals for expert review
- ▶▶ Advise patients on the best course of action to be taken if an ulcer or a new lesion occurs
- ▶▶ Provide appropriate footwear

Glossary

Cellulitis (acute inflammation of tissue): most commonly seen as a result of infection of a wound, ulcer, or other skin lesion.

Charcot's osteopathy: a chronic, progressive, degenerative disease due to neuropathic bone and joint disease. Can cause severe foot deformity.

Crepitus (in the joint): abnormal grinding/cracking noise or sensation on palpation.

Erythema: redness of the skin due to inflammation/ infection.

Lymphangitis: a state of inflammation of the lymphatic vessels seen radiating from a site of infection.

Phlegmon: purulent inflammation of connective tissues.

Probe to bone test: The probe to bone test involves carefully inserting a blunt sterile probe into a wound to establish whether the wound extends to bone (a potential marker of bone infection).

Purulent exudate: fluids, cells, or other cellular substances that are discharged from blood vessels, usually from inflamed, infected tissues.

advice that will minimise ulceration risk

- ▶▶ Advise on basic foot care to reduce ulceration risk.

The above strategies, combined with optimal glucose levels and appropriate lifestyle changes, should help to minimise ulceration risk and promote healing in the case of established foot ulcers.

Conclusion

Prevention of diabetic foot ulceration should be the primary

goal for all involved in diabetic foot care. This can be achieved with regular risk assessment, risk classification and coordinated diabetes care from both non-specialist and specialist healthcare practitioners. In the case of established diabetic foot ulcers, coordinated care from a network of skilled professionals is crucial to ensure management strategies are based on best evidence, address clinical guidelines, while also meeting the needs of the patient. This article has explored 10 key areas to encourage an evidence-based, systematic approach to diabetic foot ulcer management. **WE**

Armstrong DG, Lavery LA (2005) Negative pressure wound therapy after partial diabetic foot amputation: a multicentre, randomised controlled trial. *Lancet* **366**: 1704–10

Cavanagh PR, Lipsky BA, Bradbury AW et al (2005) Treatment for diabetic foot ulcers. *Lancet* **366**: 1725–35

Cutting KF, White RJ, Mahoney P et al (2005) Understanding wound infection. In: European Wound Management Association (EWMA) Position Document: *Identifying Criteria for Wound Infection*. London: MEP Ltd: 2–5

DoH (2001) *National Service Framework for Diabetes: Standards*. Department of Health (online) available at: http://www.dh.gov.uk/PublicationsAndStatistics/Publications/PublicationsPolicyAndGuidance/PublicationsPolicyAndGuidanceArticle/fs/en?CONTENT_ID=4002951&chk=09Kkz1 (last accessed 26/02/07)

Edmonds ME, Blundell MP, Morris ME (1986) Improved survival of the diabetic foot: the role of a specialized foot clinic. *Q J Med* **60**(232): 763–71

Edmonds M (2005) Infection in the neuroischaemic foot. *Lower Extremity Wounds* **4**(3): 145–53

Edmonds M, Foster AVM (2006) ABC of wound healing. Diabetic foot ulcers. *BMJ* **332**: 407–10

Falanga V (2005) Wound healing and its impairment in the diabetic foot. *Lancet* **366**: 1736–43

Foot in Diabetes UK, Diabetes UK, The Association of British Clinical Diabetologists, The Primary Care Diabetes Society and The Society of Chiropractors and Podiatrists (2006) *The National Minimum Skills Framework for Commissioning of Foot Care Services for People with Diabetes* (online). Available at: <http://www.feetforlife.org/download/4033/NatMinSkillFramewkFootNov06.pdf> (last accessed 26/02/07)

Frykberg RG, Zgonis T, Armstrong DG et al (2006) Diabetic foot disorders: a clinical practice guideline. *J Foot Ankle Surg* **45**(5) (Supp): 1–65

International Working Group on the Diabetic Foot (1999) *International Consensus on the Diabetic Foot*. International Working Group on the Diabetic Foot, Amsterdam, The Netherlands

International Diabetes Federation Clinical Guidelines Task Force (2005) *Global Guidance for Type 2 Diabetes*. International Diabetes Federation, Brussels (online). Available at: <http://www.idf.org/webdata/docs/IDF%20GGT2D.pdf> (last accessed 26/02/2007)

McIntosh A, Hutchinson A, Home PD et al (2001) *Clinical Guidelines and Evidence Review for Type 2 Diabetes: Management of Blood Glucose*. Sheffield SchARR, University of Sheffield

McIntosh C, Newton V (2006) Managing diabetic foot ulcers: best practice. *Wound Essentials* **1**: 122–33

NICE (2004) *Clinical Guidelines for Type 2 Diabetes: Prevention and Management of Foot Problems*, *Clinical Guideline 10*. NICE, London

O'Meara S, Nelson EA, Golder S et al (2006) Systematic review of methods to diagnose infection in diabetic foot ulcers. *Diabet Med* **23**(4): 341–7

SIGN (2001) Management of diabetic foot disease. In: *Management of Diabetes: A National Clinical Guide*. Scottish Intercollegiate Guidelines Network (online). Available at:

Key Points

- » There is an urgent need for standardised care in diabetes.
- » With new evidence constantly emerging, it is difficult for the non-specialist to keep up-to-date with current best practice.
- » To understand the complexities of diabetic foot ulceration, an appreciation of the underlying disease process is necessary.
- » There are two main types of diabetes: type 1 and type 2.
- » The non-specialist can play a key role in the early detection of problems and prompt referral to the diabetes foot care multidisciplinary team.
- » Amputation risk is decreased when patients receive care from specialist foot care multidisciplinary teams.

<http://www.sign.ac.uk/guidelines/fulltext/55/section7.html> (last accessed 26/02/07)

Singh N, Armstrong DG, Lipsky BA (2005) Preventing foot ulcers in patients with diabetes. *JAMA* **293**: 217–28

UK Prospective Diabetes Study (UKPDS) (1998) Intensive blood-glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes. (UKPDS 33) *Lancet* **352**(9131): 837–53

Watret L (2005) Wound bed preparation and the diabetic foot. *Diabetic Foot* **8**(1): 18–26

Zimny S, Schaltz H, Pfohl M (2002) Determinants and estimation of healing times in diabetic foot ulcers. *J Diabetes Complications* **16**: 327–32