

Role of screening in the prevention of diabetic foot complications: A review of the literature

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Article points

1. Delays in identifying diabetic foot disease lead to increased morbidity and higher amputation rates.
2. Evaluation of local diabetic foot care pathways, and especially their implementation, is needed for all localities to assess current service provision.
3. It is the authors' view that the current level of foot care offered to people with diabetes is inadequate.

Key words:

- Diabetic foot screening
- Best practice
- Service provision
- Screening guidelines

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This article is part one of a two-part look at the role of screening people with diabetes to prevent diabetic foot complications. In this article, the authors review the literature in relation to foot screening and summarise best practice guidelines. Part two will present original data from a foot clinic in the UK, looking at whether best practice screening for the diabetic foot is a reality on the ground.

It is estimated that, by 2010, there will be 221 million people diagnosed with diabetes worldwide (Amos et al, 1997), and the latest Quality and Outcomes Framework data have shown the prevalence of diabetes in England to be 3.9% (The Information Centre, 2008). Thus, diabetes is a condition that is increasingly common in the community, and one that has major implications for healthcare professionals, as well as individuals.

A number of complications are associated with diabetes, in particular the risk of developing a foot ulcer. An estimated 5% of people with diabetes will develop a foot ulcer every year, and the lifetime risk of a person with diabetes developing an ulcer is 15% (McIntosh et al, 2003; Merza, 2003). The ultimate consequence of diabetic foot complications, without adequate management, is amputation. The relative risk of amputation associated with all types of diabetes is 13 times that of people who do not have the condition (New et al, 1998).

The principles of diabetic foot care are not new, and the need for screening and close monitoring to reduce the incidence of ulcers, ulcer recurrence, amputation and, ultimately, morbidity is well

recognised. The St Vincent Declaration (World Health Organization and International Diabetes Federation, 1990) was produced by a group of government health representatives and patient organisations from across Europe. One of the Declaration's aims was to reduce lower-limb amputations by 50% among people with diabetes. Indeed, this work was taken further in the UK when, in 1992, the Department of Health and the British Diabetic Association established a task force, the St Vincent Joint Task Force for Diabetes, to facilitate the implementation of these recommendations. This group set out some key facts and priorities and suggested the need for foot screening, education and multidisciplinary care to combat the increased risk associated with diabetes (St Vincent Joint Task Force For Diabetes, 1998).

Despite these recommendations, the current national amputation rate, 100 per week, has made the national press, with senior health representatives voicing concern (Devlin, 2008). In one study it was found that half of the people undergoing non-traumatic amputations had not received a foot review within the preceding year (Deerochanawong et al, 1992). In a study of

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2. The two major, established risk factors for diabetic foot complications are (i) a history of ulceration and (ii) a lack of sensation.
3. It is recommended that foot screenings should follow the format of a conventional clinical consultation with a history, examination and agreement of treatment regimen.

amputees, 72% of the amputations were found to have been the result of initial minor trauma with subsequent deterioration due to poor wound management (Pecoraro et al, 1990).

It is important to note that some centres in the UK already have efficient screening programmes, and are achieving significant reductions in major amputation rates and healthcare costs (McCabe et al, 1998). In one Scottish study it was shown that 98% of people presenting with a diabetic foot ulcer had already been labelled as high or moderate risk within the local screening programme, suggesting a high level of accuracy (Leese et al, 2007)

Many amputations secondary to diabetes are thought to be avoidable (McCabe et al, 1998), and it seems only sensible to concentrate efforts and resources on effective screening to reduce the risk factors associated with ulcer development and, ultimately, amputation. In this article, the authors undertake a review of the current guidelines for screening of the diabetic foot, setting out the core principles of best practice foot care. A number of publications were consulted in this process, including those produced by NICE (2004), the Scottish Intercollegiate Guidelines Network (SIGN, 2001), Clinical Knowledge Summaries (CKS, 2008) for the National Library for Health, as well as a number of peer-reviewed articles.

Screening

The goal of screening is the prevention, or early detection, of diabetic foot complications, allowing for appropriate treatment and, ultimately, a reduction in the number of people who progress to amputation. In order to achieve this, it is important to understand the aetiology and risk factors behind the diabetic foot.

It is well established that diabetes increases the risk of developing peripheral vascular disease and peripheral neuropathy, both of which potentially lead to foot problems (SIGN, 2001; NICE, 2004; CKS, 2008). In the presence of peripheral vascular disease, the distal limb is more prone to ischaemic ulceration, particularly following minor trauma. Indeed, atheromatous disease in diabetic legs tends to affect the more distal vessels, producing often multiple, diffuse lesions that in many instances are difficult, or impossible (in the case

of ectatic distal vessel disease), to surgically bypass or dilate endovascularly (Donnelly et al, 2000). The loss of sensation associated with peripheral neuropathy, commonly in a “glove and stocking” distribution, can make the limb more prone to trauma, as can autonomic and motor dysfunction that result in deformity and gait abnormalities (SIGN, 2001; NICE, 2004; CKS, 2008).

The two major established risk factors for diabetic foot disease are (i) a history of ulceration and (ii) a lack of sensation (Alder et al, 1999). Other factors that have been associated with an increased risk of foot complications, to varying degrees, include peripheral vascular disease, previous amputation, old age, duration of diabetes, plantar callus, foot deformities, cigarette smoking, visual problems, poor footwear, social deprivation and being male (Rith-Najarian et al, 1992). Some of these risk factors on their own are highly predictive of ulceration (e.g. previous amputation), whereas others in isolation are not (e.g. old age, callus); the cumulative effect of these risk factors is additive (Rith-Najarian et al, 1992).

All of the guidelines (SIGN, 2001; NICE, 2004; CKS, 2008) suggest that people with diabetes should have their feet and lower limbs assessed on a regular basis. There is currently no evidence in the literature to guide us on an appropriate frequency of screening, however general consensus is that annual review, from the time of diabetes diagnosis, is acceptable.

Screening format

It is recommended that foot screening should follow the format of a conventional clinical consultation with a history, examination and agreement of treatment regimen (SIGN, 2001; NICE, 2004). It should also encompass patient education on the diabetic foot as an element of the treatment regimen, and facilitate rapid referral to appropriate specialist teams or services as required (see page 173 for a discussion of appropriate referral).

There is no evidence in the literature linking the care setting, or type of healthcare professional performing the screening, to better outcomes. However, it is widely accepted that screenings be held in the primary care setting, and that they be performed by an appropriately trained

professional. A review group, set up by the British Diabetic Association in 1992, suggested that screening and care should be provided by a multidisciplinary diabetic foot care team (Edmonds et al, 1996). However, subsequent reviews have suggested that this is unnecessary, provided there is ready access to a specialist team, should it be required (Hutchinson et al, 2000). The NICE guidelines (2004) concluded, after a Cochrane Review comparing a number of trials (Griffin and Kinmonth, 1998), that a system of joint care, with integration of primary and secondary care, can provide a level of foot care equal to that of a hospital diabetes clinic.

History

A foot screening should start with a detailed, but focused, review of the person's diabetic history, including previous or current foot complications, education and current diabetes control, and move on to a more general medical history, such as a

history of rheumatoid arthritis, renal disease, vascular disease and previous surgery. Direct questions about symptoms of ischaemia and neuropathy should be asked. A social history should be taken to determine the ability of the person to manage their own care, their activity levels and smoking habits (SIGN, 2001; NICE, 2004; CKS, 2008).

Examination

Examination of the foot should include checking the skin for changes in colour, pain, abrasions or ulceration; checking for neuropathy, peripheral vascular disease and deformity; and assessing the appropriateness of the person's footwear (SIGN, 2001; NICE, 2004; CKS, 2008).

Neuropathy

There are a number of assessment tools for detecting the loss of sensation associated with neuropathy, including the graduated tuning fork

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1. There is good evidence suggesting that correctly fitted footwear is extremely important in reducing tissue damage in the diabetic foot.
2. Once screened, people with diabetes should be stratified into groups according to their level of risk of developing foot complications.
3. People in the high-risk category should have more frequent foot evaluation conducted by a multidisciplinary diabetic foot care team, which includes orthotists and podiatrists, to ensure the provision of intensified education and specialist footwear.

and thermal discrimination devices. Evidence suggests that using clinical disability scores, 10g monofilaments, or vibration perception thresholds are superior techniques (Young et al, 1994; Abbott et al, 1998). All three of these methods of assessing neuropathy, singly or in combination, have been shown to have benefits in selecting patients at increased risk of ulceration (Young et al, 1994; Abbott et al, 1998).

Peripheral vascular disease

It is generally agreed that absent pedal pulses are a good marker of disease and pulse examination should be used as a first-line assessment (Apelqvist et al, 1990). Although using ankle-brachial pressure indices is a recognised technique to evaluate peripheral vascular disease, its use as a screening tool in people with diabetes must be interpreted with care, due to the artificially high systolic ankle pressures that may be obtained when calcification in the media of distal arteries is present, as is common among people with diabetes (Emanuele et al, 1981).

Deformity

The person being screened's feet should be inspected for any deformities or calluses and their footwear checked so that any pressure areas can be recognised and treated before the development of tissue breakdown (SIGN, 2001; NICE, 2004; CKS, 2008). Deformities such as hallux valgus, hallux rigidus and hammer toes, as well as those associated with neuropathic change (claw toes, ankle equinus, high arch), particularly when combined with reduced sensation, significantly increase the risk of ulceration (Abbott et al, 2002). Callus formation, related to sites of increased pressure and friction, is also associated with risk of ulceration (Frykberg et al, 1998).

There is good evidence suggesting that correctly fitted footwear is extremely important in reducing tissue damage in the diabetic foot. For example, plantar pressures experienced in normal shoes are similar to those when barefoot, but are significantly reduced by high-quality cushioned trainers and are lower still in custom-built shoes (Perry et al, 1995; Kastenbauer et al, 1998). The use of custom-made foot orthoses and shoes has been shown to reduce the formation of plantar

callus, and the incidence of ulcer relapse, in people with diabetic foot disease (Colagiuri et al, 1995; Uccioli et al, 1995).

Risk stratification

Once screened, people with diabetes should be stratified into groups according to their level of risk of developing foot complications. Suggested categories are: low risk, increased/moderate risk, high risk and active foot disease (SIGN, 2001; NICE, 2004; CKS, 2008).

Low risk

People classified as low risk are those with normal sensation, palpable pedal pulses, no foot deformity, no history of previous ulceration and normal vision. It is suggested that people in this category do not need specialist input, other than annual foot screening reviews to monitor for deterioration. A management plan, including patient education, should be agreed upon (SIGN, 2001; NICE, 2004).

Moderate/increased risk

The criteria for inclusion in the moderate/increased-risk category include loss of sensation, absent pedal pulses, visual impairment, physical disability or another risk factor (see previous sections). It is recommended that these people are more frequently assessed – between 1- and 6-monthly, depending upon the severity of their condition – by a multidisciplinary diabetic foot team or chiropodist (SIGN, 2001; NICE, 2004; CKS, 2008).

High risk

This category includes people with neuropathy, absent pulses, foot deformity, skin changes or a history of ulcer or amputation. These people should have more frequent foot evaluation and this should be conducted by a multidisciplinary diabetic foot care team, which includes orthotists and podiatrists, to ensure the provision of intensified education and specialist footwear (SIGN, 2001; NICE, 2004; CKS, 2008).

Active diabetic foot disease

It is recommended that people with active foot disease, be it ulceration, infection, worsening

ischaemia or acute Charcot, should have access to a multidisciplinary diabetic foot care team within 24–48 hours of discovery of the new symptoms (SIGN, 2001; NICE, 2004; CKS, 2008).

Education

The evidence suggesting that patient education on diabetic foot care improves outcomes is not substantial. However, there have been a number of randomised studies that have shown a short-term improvement in patient knowledge and behaviour as the result of formal education programmes (Valk et al, 2002). The long-term significance of these improvements is difficult to assess, but some studies concluded that there may be a reduction in ulcer development and amputation rates, particularly for those classified as high risk (Valk et al, 2002). There is insufficient evidence to be able to specify the best type of patient education, the frequency of sessions or the most appropriate educator. However, the education package should be based on current adult teaching methods, tailored to the needs of the target population (e.g. taking into account ethnicity, age) and be of a frequency that will maintain knowledge levels to ensure adequate foot care (McIntosh et al, 2003). Patient education packages should also cover what people can expect from their healthcare provider(s) in terms of foot care.

Self-care and monitoring are at the heart of patient education on the diabetic foot. Good foot hygiene, nail care, self-examination and use of moisturisers should all be taught (SIGN, 2001; NICE, 2004; CKS, 2008). Danger signs (e.g. blood-stained callous, skin injuries and infections) should be explained and information given on how to access immediate help when discovered. The consequences of neglect should also be covered (Malone et al [1989] report on using the consequences of neglect as part of the education package). Advice on appropriate footwear should be freely available, and if possible shoes should be carefully checked for size and fit (SIGN, 2001; NICE, 2004; CKS, 2008). The authors of one study concluded that only people with severe foot deformity received benefit from therapeutic shoes and inserts, but added that people not in a regular screening programme may also yield some benefit (Reiber et al, 2002).

Appropriate referral

Diabetic foot ulceration is associated with high rates of morbidity, indeed one study identified a 13% mortality rate among people admitted to hospital with lower-limb ulceration as the primary diagnosis (Apelqvist and Agardh, 1992). As such, any active foot problems should be treated under the supervision of a multidisciplinary diabetic foot care team. Team members may vary, but should include specialist podiatrists, orthotist, nurses with training in diabetic wound care, diabetes physicians, vascular surgeons, interventional radiologists and microbiologists. Onward referrals to, and supervision of treatment with, other necessary specialists should be managed by this team. It is suggested that, for screening programmes to run effectively in the primary care setting, access to specialist services must be rapid, and there should be good communication between the primary and secondary care providers (McIntosh et al, 2003).

Discussion

A review of the literature shows that national guidelines and care pathways relating to the diabetic foot, both in regard to monitoring and treating complications, are well established, with good evidence and peer consensus to support them. The sequelae associated with poorly treated diabetic lower-limb complications, both to individuals and to the health economy, are well recorded (Ramsey et al, 1999). However, these complications are easily avoidable with implementation of the simple measures discussed here.

It is the authors' view, based on local evidence, that the current level of foot care offered to people with diabetes in the UK is inadequate (Basu et al, 2004). The St Vincent Declaration's goal to reduce amputation rates among people with diabetes has not yet been achieved. The current authors suggest that both the primary care provision of annual screening, and the provision of immediate access to multidisciplinary diabetic foot care teams fall below expected standards in many areas of the UK, with some notable exceptions.

Evaluation of current local diabetic foot-care pathways, and especially their implementation,

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would be a useful exercise for all localities to undertake to assess service provision. With the increasing incidence of diabetes, and the potential associated costs to the health service, it would appear essential for health authorities to have effective foot-care programmes in place to minimise the impact of diabetic foot complications. ■

Abbott CA, Vileikyte L, Williamson S et al (1998) Multicenter study of the incidence of and predictive factors for diabetic neuropathic foot ulceration. *Diabetes Care* 21: 1071–4

Abbott C, Carrington A, Ashe H et al (2002) The North West Diabetes Foot Care Study: Incidence of and risk factors for new diabetic foot ulceration in a community based cohort. *Diabetic Medicine* 19: 377–84

Alder AI, Boyko EJ, Ahroni JH et al (1999) Lower-extremity amputation in diabetes: The independent effects of peripheral vascular disease, sensory neuropathy and foot ulcers. *Diabetes Care* 22: 1029–35

Amos AF, McCarty DJ, Zimmet P (1997) The rising global burden of diabetes and its complications: Estimates and projections to the year 2010. *Diabetic Medicine* 14(Suppl 5): S1–85

Apelqvist J, Larsson J, Agardh CD (1990) The importance of peripheral pulses, peripheral oedema and local pain for the outcome of diabetic foot ulcers. *Diabetic Medicine* 7: 590–4

Apelqvist J, Agardh CD (1992) The association between clinical risk factors and outcome of diabetic foot ulcers. *Diabetes Research and Clinical Practice* 18: 43–5

Basu S, Hadley J, Tan RM et al (2004) Is there enough information about foot care among patients with diabetes? *International Journal of Lower Extremity Wounds* 3: 64–8

Clinical Knowledge Summaries (2008) *Diabetes Type 2 Management: Managing Foot Problems*. National Library for Health, London

Colagiuri S, Marsden LL, Naidu V et al (1995) The use of orthotic devices to correct plantar callus in people with diabetes. *Diabetes Research and Clinical Practice* 28: 29–34

Deerochanawong C, Home PD, Alberti KG (1992) A survey of lower limb amputation in diabetic patients. *Diabetic Medicine* 9: 942–6

Devlin K (2008) Diabetes sufferers need 100 amputations a week. *Daily Telegraph*, 6 July, London

Donnelly R, Emslie-Smith AM, Gardner ID et al (2000) Vascular complications of diabetes. *British Medical Journal* 320: 1062–6

Emanuele MA, Buchanan BJ, Abaira C (1981) Elevated leg systolic pressures and arterial calcification in diabetic occlusive vascular disease. *Diabetes Care* 4: 289–92

Edmonds M, Boulton A, Buckenham T et al (1996) Report of the diabetic foot and amputation group. *Diabetic Medicine* 13(Suppl 4): S27–42

Frykberg RG, Lavery LA, Pham H et al (1998) Role of neuropathy and high foot pressures in diabetic foot ulceration. *Diabetes Care* 21: 1714–19

Griffin S, Kinmonth AL (1998) Diabetes care: The effectiveness of systems for routine surveillance for people with diabetes. In: Williams R, Bennett P, Nicolucci A (eds) *Diabetes Module: The Cochrane Database Of Systematic Reviews*. The Cochrane Collaboration, Oxford

Hutchinson A, McIntosh A, Feder G et al (2000) *Clinical Guidelines and Evidence Review for Type 2 Diabetes: Prevention and Management of Foot Problems*. Royal College of General Practitioners, London

Information Centre, The (2008) *The Quality and Outcomes Framework 2007/08*. Available at: www.ic.nhs.uk/qof (accessed 18.12.08)

Kastenbauer T, Sokol G, Auinger M et al (1998) Running shoes for relief of plantar pressure in diabetic patients. *Diabetes Medicine* 15: 518–22

Leese G, Schofield C, McMurray B et al (2007) Scottish foot ulcer risk score predicts foot ulcer healing in a regional specialist foot clinic. *Diabetes Care* 30: 2064–9

Malone JM, Snyder M, Anderson G et al (1989) Prevention of amputation by diabetic education. *American Journal of Surgery* 158: 520–4

McCabe RC, Stevenson AM, Dolan CJ (1998) Evaluation of a diabetic foot screening and protection programme. *Diabetic Medicine* 15: 80–4

McIntosh A, Peters J, Young R et al (2003) *Prevention and Management of Foot Problems in Type 2 diabetes: Clinical Guidelines and Evidence*. University of Sheffield, Sheffield

Merza Z (2003) The risk factors for diabetic foot ulceration. *The Foot* 13: 125–9

New JP, McDowell D, Burns E et al (1998) Problem of amputations in patients with newly diagnosed diabetes mellitus. *Diabetic Medicine* 15: 760–4

NICE (2004) *Clinical Guidelines For Type 2 Diabetes: Prevention And Management Of Foot Problems*. NICE, London

Pecoraro RE, Reiber GE, Burgess EM (1990) Pathways to diabetic limb amputation: Basis for prevention. *Diabetes Care* 13: 513.

Perry JE, Ulbrecht JS, Derr JA et al (1995) The use of running shoes to reduce plantar pressures in patients who have diabetes. *Journal of Bone and Joint Surgery* 77: 1819–28

Ramsey SD, Sandhu N, Newton K et al (1999) Incidence, outcomes, and cost of foot ulcers in patients with diabetes. *Diabetes Care* 22: 382–7

Reiber GE, Smith DG, Wallace C et al (2002) Effect of therapeutic footwear on foot reulceration in patients with diabetes: A randomized controlled trial. *Journal of the American Medical Association* 287: 2552–9

Rith-Najarian SJ, Stolusky T, Gohdes DM (1992) Identifying diabetic patients at high risk for lower-extremity amputation in a primary health care setting. *Diabetes Care* 10: 1386–9

Scanlon P, Stratton I (2008) *Incidence and Prevalence of Diabetes*. National Library for Health, London

Scottish Intercollegiate Guidelines Network (2001) *Management of Diabetes*. Scottish Intercollegiate Guidelines Network, Edinburgh

St Vincent Joint Task Force For Diabetes (1998) *St Vincent Joint Task Force For Diabetes: The Report*. Department of Health, London

Uccioli L, Faglia E, Monticone G et al (1995) Manufactured shoes in the prevention of diabetic foot ulcers. *Diabetes Care* 18: 1376–8

Valk GD, Kriegsman DM, Assendelft WJ (2002) Patient education for preventing diabetic foot ulceration: A systematic review. *Endocrinology and Metabolism Clinics of North America* 31: 633–58

World Health Organization, International Diabetes Federation (1990) *Diabetes Care and Research in Europe: The St Vincent Declaration*. *Diabetic Medicine* 7: 360

Young MJ, Breddy JL, Veves A et al (1994) The prediction of diabetic neuropathic foot ulceration using vibration perception thresholds: A prospective study. *Diabetes Care* 17: 557–60