Foot examinations for children and young people with diabetes: When, why and how?

Richard Leigh

Foot ulceration, gangrene and amputation remain a distressing and costly complication of diabetes. There have been many publications regarding guidance on foot examination in diabetes (such as National Institute for Clinical Excellence [NICE], 2004a; NICE, 2004b). However, little of this has focused on foot examination for children and young people with diabetes. There is evidence to suggest that foot examination should begin early, since early detection of foot pathology can prevent major complications (McCabe et al, 1998). This article provides an overview of foot examination in diabetes and considers when, why, and how diabetic foot examination should start in young people with diabetes. It also considers some of the frequently asked questions regarding foot examination in this population.

Article points

1. Preventing diabetic foot pathology requires regular foot examination.
2. Starting early foot examination in children may improve awareness of foot disease.
3. It can be easier to establish foot checks as part of the daily routine with children.
4. All people with diabetes should have open access to foot services.
5. A multidisciplinary-team approach should ensure consistent advice.

Key words

- Children and young people
- Foot examination
- Screening
- Complications

In a recent publication from the National Diabetes Support Team it is reported that 5000 people with diabetes have an amputation in the UK each year (National Diabetes Support Team, 2006). Appropriate foot care and examination play an essential role in preventing ulceration, gangrene and amputations. The National Institute for Health and Clinical Excellence (NICE; formerly the National Institute for Clinical Excellence) guideline on type 1 diabetes states that 'children and young people with type 1 diabetes should be offered annual foot care reviews' (NICE, 2004b). Type 2 diabetes is now increasing in the young population, due to poor diet and a lack of exercise (Love and Zeitler, 2001), and the foot care guideline for people with type 2 diabetes (NICE, 2004a) states:

'Regular (at least annual) visual inspection of patients' feet, assessment of foot sensation, and palpation of foot pulses by trained personnel is important for the detection of risk factors for ulceration.'

This poses the question: 'At what age should foot examination start?' In the very young, neurological and vascular examination may seem inappropriate (as the child has to go through a lot of other tests related to his or her diabetes, and the results of the foot examination are usually normal), if not impossible to achieve from a practical point of view.

A recent statement on diabetic neuropathies from the American Diabetes Association (Boulton et al, 2005) recommends that:

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1. A statement from the American Diabetes Association implies that children from the age of 5 years upwards, dependent on the year their diabetes was diagnosed, should have an annual foot examination.
2. Early detection of foot pathology by examination and awareness by the person with diabetes can prevent major foot complications.
3. In children, there may be little to report from neurological and vascular tests carried out during the examination. However, the examination process may be beneficial for a number of reasons.

'All patients with diabetes should be screened for DPN [distal symmetric polyneuropathy; the most common form of diabetic neuropathy, which most often develops in the feet (Boulton et al, 2005)] at diagnosis of type 2 diabetes and 5 years after the diagnosis of type 1 diabetes and at least annually.'

This implies that children from the age of 5 years upwards, dependent on the year their diabetes was diagnosed, should have an annual foot examination.

The aims of foot examination in diabetes

Early detection of foot pathology by examination and awareness by the person with diabetes can prevent major foot complications (McCabe et al, 1998). In children, there may be little to report from neurological and vascular tests carried out during the examination. However, the examination process itself may be beneficial for the following reasons.

- Foot testing becomes part of the regular review pattern.
- The clinician can encourage optimal glycaemic control to reduce diabetes-related pathology.
- Advice regarding daily foot care and foot awareness can be established early.
- Questions and anxieties regarding foot problems, often from parents, can be answered at the examination.
- Minor foot problems, such as verrucae, can be treated appropriately.
- In the author's experience, foot examination is often an enjoyable experience for children (unlike blood tests, for example).
- Detection of foot pathology (whether related to diabetes or not – for example fungal infection, ingrowing toenails and verrucae, which may become problematic in the neuroischaemic foot) can be referred for appropriate treatment.

The setting

A 'one-stop shop' is probably the best situation for reviewing children as they can then see the different multidisciplinary team members (including the specialist paediatrician, nurse, dietitian and podiatrist) in one session. This enables the multidisciplinary team to discuss any issues regarding ongoing care and give consistent advice. It also reduces the number of hospital visits, which are time consuming and costly in both educational and financial terms for the child and his or her family. It may also encourage attendance.

In the author's opinion, an instant-access foot examination service should be available for all people with diabetes and parents are advised to contact the service should there be any concerns regarding foot problems. While such a resource is often feasible in a large hospital setting, in reality many diabetes services have access to smaller, community-based podiatry facilities.

However, foot examination for people with diabetes may be carried out by any healthcare professional with the correct training, and this can enable good foot care to be achieved where resources and staff are limited. Some teams offer evening sessions to accommodate schooling and parents' work needs. School exam times and holidays should also be considered before arranging appointments.

If possible, the author believes that the

Figure 1. Palpation of the posterior tibial (top) and dorsalis pedis (bottom) arteries.

examination should be held away from the adult clinic, following the recommendation from the National Service Framework for children (Department of Health, 2003) that:

> *'Care will be provided in an appropriate location and in an environment that is safe and well-suited to the age and stage of development of the child or young person.'*

Foot examination in children and young people

Neurological and vascular assessment are essential as part of an annual foot examination in diabetes (Bild et al, 1989). Neuropathy occurring in children and young people with diabetes tends to be sub-clinical (Donaghue et al, 1996) but may correspond with high blood glucose levels. Most nerve disturbances at this time can be resolved through optimal glycaemic control (Assem et al, 2005).

Neuropathy

Testing for neuropathy can be achieved with vibration sensation (using a 128 Hz tuning fork) and a 10-gram monofilament (Perkins et al, 2001). The clinician should first perform the tests on the back of his or her hand to show that the sensations are not painful. The tests should then be repeated on the child's hand, so that he or she can experience the sensation, before proceeding to examine the feet.

The assessment is carried out as follows.

- **Tuning fork.** Place the tuning fork on the great toe and ask if it feels like the sensation on the child's hand.
- **10-gram monofilament.** Ask the child to close his or her eyes and say 'yes' if he or she feels the monofilament touching the skin. The ideal number of sites that need to be evaluated is contentious and the optimal sites to be tested are still unclear (Rheeder et al, 2002). However, four or more is considered sufficient to detect neuropathic changes (e.g. testing at the great toe and first, third and fifth metatarsal heads) – clinical trials by Smieja et al (1999) and Jirkovska et al (2001) showed that testing four sites gave good sensitivity (93%) and increasing specificity with the number of insensate sites found.
- **Reflexes.** Experienced clinicians may also examine ankle or patella reflexes, but these may be difficult to achieve (and the results therefore misleading) in children.

Vascular status

Testing the vascular supply in the foot can be achieved by palpation or Doppler ultrasound (with an 8 MHz probe). In the author's experience, children find the Doppler ultrasound fascinating and it is often a trigger to encourage future foot reviews. The arteries to check during the examination are as follows.

- **Dorsalis pedis artery.** Found on the dorsum (upper surface) of the foot, proximally to the cleft between the first and second toe (*Figure 1*).
- **Posterior tibial artery.** Found distal and posterior to the medial malleolus (the inner bony prominence of the ankle; *Figure 1*).

The foot examination should also include:

- a general examination of skin and nail condition
- a consideration of foot shape and toe position

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Table 1. The author's foot care advice for children and young people with diabetes.

- **Optimisation of glycaemic control.** This plays a major part in preventing foot pathology (Reichard et al, 1991).
- **Daily foot inspection.** People with diabetes should check their feet for signs of cuts, discolouration, swelling and skin and nail changes. Cuts and infections should be dry-dressed and checked by a podiatrist or doctor as soon as possible (Society of Chiropodists and Podiatrists, 2004).
- **Daily foot washing.** This is important to the maintenance of healthy skin.
- **Cutting nails correctly.** People with diabetes should not cut, probe or pick at the sides of their toenails. This can lead to an ingrowing toenail and infection. Cut along the free edge of the nail and file rough edges if necessary.
- **Management of hard skin.** People with diabetes should not attempt to remove hard skin. Corns and callus should be removed by a podiatrist.
- **Smoking cessation.** Smoking can be a problem with teenagers. They should be made aware that smoking can damage the arteries in their legs (Heeschen et al, 2001) and cause other fatal disease.
- **Remember that foot examination is part of the annual review.**

Page points

1. It is important to establish a routine of good foot care for children and young people with diabetes.
2. With young children, their parents play the most important role in education.
3. The annual foot examination is a useful time in which to discuss questions relating to foot care and diabetes.
4. In the author's experience, reassurance and consistent advice from the team can be invaluable.

(e.g. clawed toes)
- a footwear check.

If there are any problems found during examination, they should be referred to the diabetic foot team or appropriate specialty. There are other childhood disorders which may cause lower limb pathology (such as avascular necrosis [e.g. Freiberg's], demyelinating neuropathies [e.g. multiple sclerosis] and myopathic disorders [e.g. Duchenne muscular dystrophy]) and these may also require specialist examination.

Advice on foot care

It is important to establish a routine of good foot care for children and young people with diabetes.

With young children, their parents play the most important role in education. They may also have concerns regarding foot care. The important points are summarised in *Table 1*.

Frequently asked questions

Children and young people with diabetes and their parents often have many questions relating to foot care and diabetes. The annual foot examination is a useful time in which to discuss these. There may be concerns about minor foot pathology and many have heard horror stories about people with diabetes losing their legs. In the author's experience, reassurance and consistent advice from the team can be invaluable. Some of the most frequently asked questions, and appropriate responses, are listed below.

'How does diabetes affect my feet?'

As with most complications of diabetes, poor glycaemic control (not keeping blood glucose levels under control) can cause damage to blood vessels and nerves (Duby et al, 2004). The blood vessels can become narrowed or blocked, stopping blood flow to the legs and feet. Nerve damage can lead to a loss of the pain sensation which protects the foot from injury.

'Is foot disease inevitable?'

By maintaining good glycaemic control, following advice on foot care and attending for regular foot examination, feet can be kept in good condition.

'What do I do if I notice something wrong?'

In this situation, medical advice should be sought from either a podiatrist or a doctor. They can deal with problems quickly and are always happy to check that feet are healthy.

'What is a verruca and can I use over-the-counter products to treat it?'

A verruca is caused by a viral infection. It causes changes in the skin that can create hard lumps. Always seek advice before starting treatment as verruca treatments can contain acids to remove the infected skin which may cause a chemical burn (Cooper, 2005), leaving the area open to bacterial infection.

'My child has "flat feet" – should I be concerned?'

As children grow, their foot shape changes (McIntyre, 1969). This corresponds with bone growth in the feet, legs and hips (LeVeau and Bernhardt, 1984). If the child has problems walking or running he or she may need an assessment for insoles from a podiatrist. However, most children do not need any intervention.

'What is the best type of shoe?'

It is important to wear the correct shoe for the activity being done. A lot of young people spend all day in trainers, which often have polyester linings (similar to putting the foot in a plastic bag). This can be a problem if the feet are sweaty (hyperhydrotic), leading to athlete's foot (onychomycosis) and 'in-growing' toenails (the nail plate becomes saturated and can tear easily [Burns, 1996]).

The best day-to-day (school) footwear should have a leather upper (which will allow sweat to evaporate) and a man-made sole. The shoe should have laces, buckles or Velcro to prevent movement and skin rubbing (Society of Chiropodists and Podiatrists, 2002). Finally, a child should always wear the correct footwear for sports to prevent injury.

'What is an "ingrowing" toenail?'

Ingrowing toenails tend to occur when a sharp piece of nail cuts into the skin along the side of the nail. This may occur after poor nail cutting

or if the nail breaks or tears (Burns, 1996). The damaged skin can become infected, causing redness, pain and pus. Sometimes the skin can try to repair but forms a network of small blood vessels which can overgrow the nail (hypergranulation tissue). These conditions can be treated, but are far better prevented (Burns, 1996).

'Will exercise damage my feet?'

Exercise is good for the cardiovascular system and will help maintain a healthy heart and circulation. It is also good for controlling weight and (in type 2 diabetes) blood glucose level. Feet should be checked after exercise as part of the daily foot care routine. Timing of meals, insulin dose and blood glucose checks should be discussed with the team to avoid hypoglycaemia during exercise.

Conclusion

The current guidance for foot examination requires better definition for children and young people with diabetes. However, annual foot reviews are an essential part of ongoing care for people with diabetes and should include testing for neuropathy, vascular status, general condition of the foot, footwear and foot care advice.

Starting foot examination and education early can establish foot checks as part of daily routine and the need for regular examination. This should improve detection of diabetic foot pathology at the earliest possible stage and aid the prevention of lower limb disease. ■

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