

## Review

# Prevention of Diabetic Foot Ulcers at Primary Care Level

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## ABSTRACT

Diabetic foot ulcer (DFU) prevention is best achieved at primary care level and should begin with education, appropriate protective footwear, glycaemic control and regular screening for loss of protective sensation. In the west, specialized diabetic or podiatry clinics may assess and quantify neuropathy with many tools including monofilaments, biothesiometry, corneal confocal microscopy and nerve conduction studies. Vascular assessment can be done *via* measuring ankle-brachial index, duplex ultrasound studies and toe pressure. Other foot assessment may include measuring plantar foot pressure using computerized dynamic foot studies (computerized insole sensor system). The ability to stratify patients based on risks is carried out on the basis of a thorough medical and surgical history in conjunction with these measurements thereby allowing clinicians to determine the type of intervention. Effective strategies for foot ulceration prevention include educating patients, their families, and healthcare workers about adequate foot care and regular foot examinations along with optimal glycaemic control and smoking cessation. Other effective clinical interventions may include, foot hygiene, debridement of calluses, management of foot deformities which may at times require prophylactic foot surgery. Counseling patients regarding daily proper footwear and hygiene should be stressed during each clinic visit. Educating, screening and managing patients with diabetic foot ulceration and or complications is an essential primary healthcare strategy to prevent unnecessary morbidity and mortality related to diabetic foot. An integrated (interdisciplinary) approach including, family physicians with special interest in the diabetic foot, diabetic educators, nurses and family members is a vital component in this regard.

### Keywords

Diabetic foot ulcer (DFU); Neuropathy; Glycaemic control.

## INTRODUCTION

Diabetic foot ulcer (DFU) is the most common and neglected complications of diabetes. The risk of death for those with foot ulcers is 12.1 per 100 person-years of follow-up compared with 5.1 in those without foot ulcers.<sup>1</sup> Similarly, the risk for amputation in patients with diabetes is 15 times greater than for the non-diabetic population and the majority of amputations are preceded by DFU.<sup>2</sup> It is documented that subjects with foot ulcers have a poor quality of life and nearly 15% of all diabetics will develop foot ulcers. It is also estimated that 15% of all diabetics who get admitted to hospital do so mainly due to foot problems.<sup>3</sup>

In the US, direct hospital costs for the treatment of diabetic foot infections exceeds \$200 million per year and that for am-

putation related to diabetes exceeds \$350 million annually.<sup>4</sup> However diabetic foot ulcer is preventable by appropriate education, evidence-based counseling and preventative strategy.

## PREVENTION AND TREATMENT OF NEUROPATHY

Neuropathy is the main cause that gives rise to diabetic foot ulcer especially the insensate foot. Patients might not be aware of it in the early stages, as they might not feel the pain.<sup>5</sup> Furthermore, neuropathic wound does not heal fast as it is not protected by pain sensation. Optimal glycaemic control can reduce the incidence of neuropathy and thereby foot ulcer.<sup>6</sup> Foot deformities, on the other hand, can also cause foot ulcers because of the abnormal pressure.<sup>7</sup>

In diabetes, deformity due to Charcot neuroarthropathy

is increasingly recognized.<sup>8</sup> It is very important to prevent deformity in diabetic subjects by the use of adequate footwear. Similarly, acute Charcot neuroarthropathy should be aggressively treated to maintain the normal architecture of the foot.<sup>8</sup> There has been no controlled trial on surgical correction of deformity in the prevention of ulcers but it is worth considering. Recently, surgery to lengthen the Achilles tendon has been shown to be useful in the prevention of ulceration of metatarsal heads.<sup>9</sup> If there is recurrence of ulceration over a bony prominence or on an abnormal weight-bearing part, surgical correction may be indicated.

### Key Interventions

- Regular follow-up and surveillance for diabetic retinopathy for adults with diabetes is required and early laser treatment for those identified with retinopathy is vital.
- Patients having microalbuminuria should be treated with angiotensin converting enzyme (ACE) inhibitors and their rate of progression to diabetic nephropathy.
- Strict blood pressure and blood glucose control in people with diabetic nephropathy can reduce the rate of deterioration in their renal function, as well as their risk of cardiovascular disease.

### Specific Foot Care Advice Given to Patients with High-Risk Feet in Order to Prevent DFU

- Wash your feet daily with mild soaps and keep it moisturized.
- Avoid walking barefoot indoors.
- Inspect your feet daily.
- Contact your doctor or podiatrist if there is redness or swelling or a minor cut.
- Wear well-fitting shoes which should offer enough room to move your toes freely.
- If needed wear special shoes if you have been supplied with them.
- Never self-treat your own corn or callus. Consult a doctor instead.
- Avoid using a hot water bottle.
- Wear woolen socks in bed if needed.

### General Advice Necessary to Help you Protect your Feet (Figure 1)

#### Foot Examination

1. Check your feet daily because some people may not feel injury if the nerves in their feet are not working properly.
2. So, you should look for:

- Red spots.
- Cuts.
- Blisters.
- Wet or white areas in between the toes.
- Sores.
- Any skin change.
- You should use a mirror to see the bottom of your feet.



Figure 1. General Steps to Examine the Diabetic Foot

3. If you see thickened skin area (callus) consult your doctor because it means the pressure in that area is high; therefore, you need a special insert or shoe to relieve the pressure and your doctor may want to remove the callus.
4. If your feet feel cold don't use hot water bottle because you may burn your feet without even feeling it.

### How Can I Take Care of my Feet?

1. Wash your feet daily using warm water (test it by your elbow), a mild soap and dry using a towel especially the areas between your toes.
2. Do not soak your feet because this will dry out the skin and do not use whirlpool – water if you suffer from cold feet but rather wear socks made of cotton and wool to keep your feet warm.
3. Use a moisturizer (10% urea cream) because dry skin cracks and if this happens it can lead to infection and ulcer formation.
4. Dry up between your toes after washing your feet.
5. Cutting your nails regularly once a week is usually enough but if your nails are thick; don't attempt to cut them because you may injure yourself. Your doctor can help you by using a special scissor. Nails should be cut across and not in a semi-circular fashion and use a nail clipper instead of scissor & do not cut nails too close to the skin.

### FOOTWEAR CARE

1. Never walk barefoot even inside the house, socks should be worn (cotton) all the time to keep skin moist and shoes must also be worn, to avoid injury to your feet.
2. Check your shoes before you wear them because you may find foreign bodies such pieces of stones inside.

3. Wear socks which are made of cotton or wool.
4. Shoes should be round in the front, made of leather top or canvas to let your feet breath. Remember, that you should buy shoes at the end of the day because feet swell up as the day goes on. Remember that if shoes are comfortable, when your feet are swollen at night they will be comfortable all day.
5. Avoid high heels shoes which may put extra pressure on the bottom of your feet.
6. If you want to exercise you need to wear soft tennis shoes and check your feet before and after exercise.
7. Sandals should not be worn nor should you wear nylon socks.

**Consult your doctor:** Consult your doctor before buying a new pair of shoes and if you do, you need to wear it 1 hour daily initially until it softens up slowly over several days

1. Let your healthcare provider check your feet on a yearly basis at least, but if you are suffering from one of the following you need to be checked more often:
  - A. Suffering from numbness or pins and needles in your feet.
  - B. Burning sensation in your feet.
  - C. Pain in your feet or back of your leg.
  - D. Cold sensation in your feet.
2. If you have abnormal looking toes.

**Skin care:** To help you have moist skin you need to

1. Use a moisturizer such as 10% urea cream or Lanolin.
2. Avoid barrier creams and ointments such as Vaseline because it will not moisturize your feet.
3. Avoid applying a moisturizer in between your toes.
4. Avoid Henna because it will dry your skin & cause the skin to crack.

If you see any of the following changes in the nail please consult your doctor (Figure 2).



Similarly, if you see the following changes in your skin please consult your doctor (Figure 3).



**Things you need to take care of:**

1. Keep your blood sugar under control since this will help in preventing complications and speeds up healing. This can be achieved by eating a healthy and balanced diet, exercise and proper medical follow-up.
2. Avoid smoking.
3. Have a regular follow-up with your doctor regarding foot care.
4. Report any change in your skin no matter how trivial it may look.

#### PREVENTION AND TREATMENT OF PERIPHERAL VASCULAR DISEASE

The lack of blood supply or ischemia is one of the major reasons for diabetic foot ulcers and thereafter amputations. Atherosclerotic lesions are more diffuse and distal in diabetics.<sup>10</sup> The risk of vascular diseases in diabetics can be reduced, by lifestyle modifications including daily exercise and avoiding smoking. Many drugs are out in the market promoted as being useful in the prevention of DFU and peripheral vascular disease; however, adequate controlled trials supporting these claims are lacking. Despite this, an argument for the use of aspirin, clopidogrel, statins, fibrates, ACE inhibitors and folic acid in diabetics can be made in the light of these pieces of evidence.<sup>11-14</sup> On the other hand, agents such as naftidrofuryl and cilostazol, although helpful in controlling symptoms of intermittent claudication, have not found widespread use in diabetics with peripheral vascular disease as there is paucity of data on prevention of DFU or amputation.<sup>15,16</sup> If a leg is fully ischaemic, vascular surgery could improve the blood supply.<sup>17</sup>

#### GLYCAEMIC CONTROL

Normal glucose level is the first line of defense against chronic complications of diabetes. Optimal glycaemic control may prevent the development of neuropathy. Intensive blood glucose control reduced the development of neuropathy by 40% in patients with type II diabetes<sup>18</sup> and by about 60% in patients with type 1 diabetes.<sup>19</sup> Raised HbA1c has also been associated with DFU, amputations and peripheral vascular disease. Therefore, it is very important to optimize glycaemic control to prevent DFU in the long run.

#### REGULAR PODIATRY

Podiatry services are essential in the prevention and treatment of DFU.<sup>20</sup> Patients should avoid self-treating corns and calluses and

should avoid nail clippings especially if there is retinopathy or the nails are thick, dystrophic along with the history of the peripheral vascular disease. If a callus or corn is present it ultimately leads to unnecessary shear forces and results in high pressure in the foot.<sup>21</sup> At each visit, it's the clinician utmost responsibility to examine the foot and also reinforce foot care education. Prescription footwear is of paramount importance, as it prevents pressure sores and ulcers. A shoe that allows free movement of toes is a way of identifying rightly fitting shoes.

Patients with low or medium risk of ulceration should be advised to buy good quality shoes but those with high risk and in subjects who already developed DFU, custom-made prescription footwear should be prescribed as these have been shown to prevent recurrences of DFU.<sup>22</sup> Orthotists are of great help in designing appropriate footwear especially when there is a severe foot deformity.<sup>23</sup> Patients should be advised to ensure that shoes are in a good state of repair and check for any foreign objects before they are worn.

## FOOT CARE EDUCATION

The patient should be taught about foot care. The patient or their care taker should examine the feet at least once a day if needed with the help of a mirror to look into the under surface. A proper foot care education program has been shown to reduce the risk of ulceration.<sup>24,25</sup> Patients usually become more receptive to medical advice after first ulceration, so a thorough counseling with the physician or podiatrist or specialist nurse should be arranged to discuss foot care.

## DETECTION OF HIGH-RISK FEET WITH SCREENING

Screening programs are available in various parts of the world. It's better to screen patients in 3 months after diagnosing patients with diabetes. All diabetic subjects should be offered a comprehensive foot-screening program. The patients are classified into high, medium and low-risk categories by the screening clinician depending upon previous foot ulcers, neuropathy, ischemia, deformity, smoking habit, and vision. If the patients are high or medium risk, they are screened annually by the podiatrist, but patients with low-risk feet are screened by their diabetes care provider and can be referred to podiatrist if their risk status changes.

## GENERAL PATIENT EDUCATION

There has not been any study to specifically look into various lifestyles and the development of DFU. In view of available knowledge based on the general population, the following changes can be advocated.

### Smoking

Smoking increases the morbidity and mortality of people with diabetes. Epidemiological studies revealed that diabetic subjects who smoke may have an increased risk of foot complications. All patients should be encouraged to stop smoking.

### Diet

Maintenance of adequate and balanced diet is the main treatment for diabetes to improve glycaemic control. Obesity should be prevented. These subjects should be actively encouraged to lose weight if they are obese. This will not only improve the diabetes control but will also reduce the pressure on the foot. Similarly, a low-fat diet is important to reduce cardiovascular disease.<sup>26</sup>

### Exercise

Exercise is the cornerstone and prevents peripheral neuropathy. Exercise or activity is beneficial for people with diabetes. Physiotherapy can correct the gait abnormality and possibly prevent the development of DFU.<sup>27</sup>

### Alcohol

Excessive intake of alcohol has been associated with the development of diabetic neuropathy.<sup>28</sup> On the other hand, moderate consumption has been shown to improve diabetes control and mortality in general population including diabetic subjects.<sup>29</sup> Men should drink no more than 21 units and women no more than 14 units each week.

## CONCLUSION

It is essential to screen diabetic patients to identify those at risk for foot ulceration. Prevention of diabetic foot ulcer is best achieved through effective health education<sup>30</sup> and evidence-based counseling to the patient and family, early identification, regular assessment and proper foot examination. Specialized clinics such as podiatric clinic use advanced foot assessment methods to determine the type of clinical intervention which proves beneficial for diabetic patients.

## CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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