

## **THE DIABETIC FOOT. Guidelines for prevention**

**The information provided is modified from information disseminated by the International Consensus on the Management and the Prevention of the Diabetic Foot (1999-2003).**

### **Introduction**

The aim of the present document is to provide guidelines for management and prevention that will reduce the impact of diabetic foot disease, by means of quality health care with consideration of costs and using the principles of evidence based medicine augmented with expert opinion. In the document the basic concepts in diabetic foot care are addressed, with clear description of the various diagnostic, preventive or therapeutic strategies. Foot complications are one of the most serious and costly complications of diabetes mellitus. Amputation of (part of) a lower extremity is usually preceded by a foot ulcer. A strategy which includes prevention, patient and staff education, multi-disciplinary treatment of foot ulcers and close monitoring can reduce amputation rates by 49-85%. Therefore, several countries and organizations, such as the World Health Organization and the International Diabetes Federation, have set goals to reduce the rate of amputations by up to 50%

### **Epidemiology of the diabetic foot**

- Approximately 40-60% of all (non)-traumatic amputations on the lower limb are performed on patients with diabetes.
- 85% of diabetes-related lower extremity amputations are preceded by a foot ulcer.
- Four out of five ulcers in diabetic subjects are precipitated by external trauma.
- The prevalence of foot ulcer is four to ten percent of the diabetic population.

The major adverse outcomes of diabetic foot problems are foot ulcers and amputations. A wide variation in amputation rates has been documented between various countries and geographic regions. Approximately 40-60% of all non-traumatic lower leg amputations are performed in patients with diabetes. In most studies the incidence of lower leg amputation has been estimated to be between 7-206/100,000 inhabitants/year. The highest figures have been reported for Indian reservations in the USA and the lowest incidences are found in areas in Denmark and Great Britain.

However, adequately performed population-based studies regarding incidence of amputation in the lower leg are scarce, especially in the less developed countries. The difference in incidence is in many cases due to differences in the design of the study, demographic factors and prevalence of diabetes, as well as variations in registration systems, and differences in reimbursement of various procedures. It has been reported that in up to 15-19% of diabetic patients undergoing an amputation diabetes was first diagnosed at the time of surgery. Diabetic patients more frequently have below ankle amputations than non-diabetic patients. As a consequence, studies which focus primarily on above ankle amputations tend to underestimate the total number of diabetes-related amputations.

Therefore, all levels should be taken into account when amputations are reported. In developed

countries amputations also seem to be underestimated if a continuous registration system is not in place. Taking into account these factors, the most common incidence of diabetes-related amputations is likely to be between 5-24/100,000 inhabitants/year or 6-8/1000 diabetic subjects/year.

Foot ulcers are documented to precede approximately 85% of all diabetic amputations. The proportion of patients undergoing amputation with gangrene in various studies was found to be between 50-70% and infection was found to be present in 20-50% of patients. In most cases amputation had to be performed because of the combination of deep infection and ischemia. The most common indications for amputation described in the literature are gangrene, infection and a non-healing ulcer. Although frequently reported as such, a non-healing ulcer should not be considered an indication for amputation.

The point prevalence of foot ulcers in developed countries has been estimated to be approximately 4-10% of diabetic individuals. A corresponding incidence of 2,2 -5,9% has been reported. It has to be recognized that most of these data are based on cross-sectional studies of selected patient populations of diabetic subjects who tend to be below 50 years of age. In studies focusing on younger subjects with either type 1 or type 2 diabetes, prevalence has been estimated to be between 1,7 - 3,3% compared to 5-10% when the majority of patients are either older or have type 2 diabetes.

When discussing risk factors for the diabetic foot it is important to differentiate between factors related to peripheral neuropathy and peripheral vascular disease, those related to the development of foot ulcers, and those related to amputation. In most cases, risk factors associated with the development of a foot ulcer have been considered similar to those for lower extremity amputation. This, however, has not been proven. Furthermore, studies discussing risk factors usually include type 1 or young type 2 diabetic patients from highly specialized foot-care centers, have small sample sizes, are retrospective, cross-sectional and, most commonly, not population-based.

Numerous factors have been suggested to be related to the development of foot ulcers (table). Male sex has been associated with an increased risk of ulcers and amputation in most studies of type 2 diabetes, but these findings are inconsistent. There is general agreement that the most important risk factor for developing a foot ulcer is the presence of peripheral sensorimotor neuropathy. The estimated prevalence of peripheral neuropathy varies from 30-70%, depending on the populations studied, definitions and diagnostic criteria. Eighty to ninety percent of foot ulcers described in cross-sectional studies were precipitated by external trauma (usually inadequate or illfitting shoes).

In these studies the proportion of purely neuropathic lesions, neuroischemic lesions, and purely ischemic lesions varied extensively. Approximately 70- 100% of ulcers had signs of peripheral neuropathy with various degrees of peripheral vascular disease. In a cross-sectional, population-based study the proportion of neuropathic, neuro-ischemic lesions and ischemic lesions was 55%, 34%, and 10% respectively. Only 1% of the ulcers was considered not to be diabetes-related. Furthermore, in this study 47% of the ulcers were not previously known to the physicians. The prevalence of peripheral vascular disease in diabetic subjects defined as symptoms or signs including ankle brachial index below 0.8-0.9 has been estimated to be 10-20% in different studies.

## **Peripheral vascular disease and diabetes**

- Peripheral vascular disease is the most important factor related to outcome of a diabetic foot ulcer.
- Peripheral vascular disease can often be recognized by simple clinical examination: color and temperature of the skin, palpation of pedal pulses, ankle blood pressure measurement.
- The probability of a diabetic foot ulcer healing can be estimated using noninvasive vascular tests. Ankle and occasionally toe blood

- pressure readings may be falsely elevated due to medial sclerosis.
- Rest pain due to ischemia may be absent in diabetic patients (probably) due to peripheral neuropathy.
- Micro-angiopathy should never be accepted as the primary cause of an ulcer.
- Conservative approaches should involve a walking program (if no ulcer or gangrene is present), appropriate foot wear, cessation of smoking and aggressive treatment of hypertension and dyslipidemia.
- Patency rates and limb salvage rates after revascularization do not differ between diabetic and non-diabetic patient; therefore, diabetes is not a reason to withhold this treatment.

### Biomechanics and footwear

- Biomechanical abnormalities are frequently a consequence of diabetic neuropathy and lead to abnormal plantar foot pressure.
- A combination of foot deformity and neuropathy increases the risk of ulcer.
- Pressure relief is essential for the prevention and healing of an ulcer, as abnormal foot pressures lead to plantar ulceration.
- Shoes and inserts should be inspected frequently and replaced when necessary.
- A patient should never return to footwear which has caused ulceration.
- Appropriate footwear (adapted to high pressures, deformities, and/or lesions present in the foot) has been associated with significantly fewer recurrences and development of ulceration.

### Factors contributing to abnormal foot pressure (and possibly shear stress)

#### Intrinsic Factors

Bony prominences  
 Limited joint mobility  
 Joint deformity  
 Callus  
 Altered tissue properties  
 Previous foot surgery  
 Neuro-osteoarthropathic joints

#### Extrinsic Factors

Inappropriate footwear  
 Walking barefoot  
 Falls and accidents  
 Objects inside shoes  
 Activity level