Amputations in people with diabetes

Introduction

85% of all amputations are preceded by a foot ulcer. Therefore, early and adequate treatment of these ulcers is mandatory to prevent amputations. Promising results of a gradual reduction in the number of lower-leg amputations have been reported in several population-based studies and, after correction for the increasing number of people with diabetes, a relative decrease in the number of lower-extremity amputations in people with diabetes was observed in some countries. In general, the more distal an amputation the smaller the loss of load-bearing capacity, stability and mobility, and the smaller the increase in cardiopulmonary stress. However, this procedure should be performed in such a way that the residual limb allows weight bearing, and that it can be accommodated, if necessary, in a prosthesis, orthosis, or special shoe.

An amputation level should be chosen at which post-operative healing is very likely, but patient characteristics should also be taken into account. For example, even in a permanently bedridden patient with a poorly healing ulcer, a lower-leg amputation can markedly increase quality of life. Adequate tissue perfusion is a major determinant of post-operative wound healing, making pre-operative assessment of vascular status essential (see chapter on Peripheral vascular disease), although the level of amputation is determined largely by the extent of the damaged tissues. If the ankle pressure is <50 mmHg or toe pressure (or TcPO2) is <30 mmHg, the probability of healing of a toe or forefoot amputation is markedly reduced.

Minor amputations (midtarsal or distal amputations)

Minor amputations may be indicated to remove gangrene, after revascularization for ischaemia for example, as part of a debridement for foot infection, or for correction of foot deformities likely to cause ulcers.

Prospective studies on healing after (minor) amputations are scarce and more information is needed.
needed. There are only a few studies of long-term mortality, co-morbidity, the development of new foot lesions, and subsequent new or second-leg amputations. The major risk factors for a minor amputation are: depth of the ulcer, peripheral arterial disease, and infection. In two studies, in which patients were followed for more than 5 years, a second, ipsilateral amputation was performed in more than 40% of patients; the contralateral major amputation rate was 30% and more than 50%, respectively.

When an amputation wound is closed primarily, the tissues must be free of infection and well perfused. Open amputations are often necessary when debriding infected and necrotic tissues. It is often possible to save important weight-bearing areas using limited resection with open wound management. In the case of large or deep wounds, skin grafts and reconstructive plastic surgery with free tissue transplants can be considered. During the early, post-operative phase, antibiotic therapy and avoidance of weight bearing play important roles. As described in the chapter on ulcer management and outcome, optimal metabolic control and treatment of malnutrition are also important.

Amputation for gangrene by spontaneous demarcation (auto-amputation) in people with diabetes often takes several months with a constant risk of invasive infection from the demarcation zone. Expert opinion favours surgical resection of gangrene whenever a joint or tendon is involved, provided that the arterial supply is adequate for healing (following arterial reconstruction, for example).

Once mobilized, the patient may walk with a therapeutic shoe or orthosis until healing is complete. Although healing may take several months, minor amputations do not significantly compromise the ability to walk, but may result in progressive deformity with an increased risk of ulceration and new amputation. In the experience of several experts, hallux amputations in particular may be associated with progressive deformity and/or recurrent plantar foot ulceration. Also, removal of one of the lesser toes can result in a progressive dislocation of the neighbouring toes, finally leading to new interdigital pressure ulcers. An orthosis which fills the gap left by the amputated toe might prevent these deformities and ulcerations.

If an amputation has been performed, the risk of further ulceration may be increased and lifelong close surveillance is indicated, with special attention paid to footwear - which needs to be modified or custom-made in many cases.

**Major amputations (any resection proximal to midtarsal level)**

Severe ischaemia in a leg that cannot be revascularized is the most important reason for a lower-leg amputation. Before an amputation is performed, a revascularization procedure should always be considered first. In a recent study, other risk factors were: age, female sex, visual impairment and the size of the ulcer. Major amputations are associated with a high mortality rate and a considerable risk of loss of walking ability and independence among survivors. Long-term results also suggest a high risk of a major second leg amputation.

It should be emphasized that a non-healing ulcer is not an indication for a major amputation. Major amputation is indicated to treat progressive ischaemic necrosis or severe rest pain, which for some reason cannot be treated by revascularization, controlled with drugs or relieved with a minor amputation. Another indication is severe progressive diabetic foot infection in a leg without significant arterial disease, with or without sepsis, which cannot be controlled by debridement and optimal conservative treatment, including antibiotics active against the causative micro-organisms. Occasionally, severe neuro-osteoarthropathic deformities may require major amputation. Thus, the absence of critical ischaemia by no means excludes the risk of amputation. Amputations due to non-ischaemic conditions are, however, often the result of delayed or inadequate treatment. A major goal for foot care specialists, therefore, is to prevent amputations for non-ischaemic reasons, just as vascular surgeons should strive to prevent amputations due to ischaemia.

To facilitate rehabilitation, it is most important to retain the knee. Primary transfemoral amputation is indicated in patients in whom major wound complications cannot be tolerated. A transfemoral amputation or knee disarticulation should also be considered in those patients with a contracture of
the knee joint, or who are bed-bound or otherwise severely disabled. Such patients are better off with a long stump which facilitates sitting and movements in bed. In some patients with critical ischaemia without the possibility of revascularization, tissue perfusion below the knee is so poor that a higher level of amputation should be selected. The amputation level with a reasonable chance of post-operative healing can be defined using techniques such as measurements of skin oxygen perfusion pressure (TcPO2), Doppler popliteal systolic blood pressure, and skin blood-flow by radioactive isotopes or laser-Doppler. Post-operative mortality is significantly higher in transfemoral amputations (10-40%) than in transtibial amputations (5-20%), probably because more fragile patients are selected for primary transfemoral amputation.

After a major amputation, the patient should participate in a tailor-made rehabilitation programme, which should preferably be started prior to the amputation. It is assumed that the results of rehabilitation and prosthesis fitting are comparable for people with or without diabetes, although no studies have been published on this subject. In centres of excellence, as many as 80% of amputees have been successfully fitted with a prosthesis, but most of these studies are based on selected patient groups fit enough for rehabilitation. Advanced age (>80 years), living alone and the presence of other chronic diseases greatly reduce the chances of independent walking after a major amputation.

As patients who have undergone a major amputation have a high risk of subsequent contralateral amputation, a surveillance programme for the remaining foot is crucial. There are few studies regarding time to heal and factors related to reamputation for people with diabetes. Long-term survival is poor in patients with a major amputation; in some studies, less than 40% were alive after 3 years.

Further reading


Amputation levels of the leg
Amputation levels of the foot

1. Toe amputation
2. Toe disarticulation
3. Distal transmetatarsal amputation
4. Proximal transmetatarsal amputation
5. Tarsometatarsal disarticulation
6. Midtarsal disarticulation
7. Intertarsal disarticulation

TF = Transfemoral
KD = Knee disarticulation
TT = Transtibial
AD = Ankle disarticulation