

The multidisciplinary rehabilitation of patients after lower-limb amputation

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Article points

1. The multidisciplinary rehabilitation of patients after lower-limb amputation is challenging, but very rewarding.
2. Gains for the patient in regard to mobility and independence are very achievable when team input is given in a timely way.
3. Heightened awareness in the patient of the need for care of the contralateral foot is important as a new phase of mobility begins.

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Timely multidisciplinary assessment if necessary for all patients who will need or who have already had a lower-limb amputation. The focus of the assessment is to maximise strength, transfer ability and achieve safe seating, with the main goal of improving independence starting before the time of amputation if possible. Not every patient will be able to walk with a prosthesis. A cosmetic prosthesis can be offered to those patients who do not have the ability to walk again. The choice of the most suitable prosthesis should be multidisciplinary, bearing in mind the likely activities to be achieved, balance and component specifications. Care of the remaining foot is of great importance.

Rehabilitation is defined as the restoration of someone to health or normal life through training and therapy (Oxford Learner's Dictionary, 2019). While amputee rehabilitation aims to restore function and quality of life, unfortunately, amputation of a leg inevitably leaves a lasting impact on the life of that person, their friends and family. Diabetes mellitus (DM) is the most common cause of lower-limb amputations in the world. In Northern Ireland, there has been a 60% increase in the number of people diagnosed with DM in the past 12 years. As Armstrong et al (1997) and Lacroix et al (2000) have reported, men with DM more frequently require lower-limb amputation than women, although women are more likely to be more ill and have a worse prognosis after amputation. According to Limbless Statistics, a repository for quantitative information on the entire UK limbless population, there were 5,427 lower-limb amputee patients referred for consideration of rehabilitation and/or prosthetic treatment between 2011–2012 (University of Salford, 2015). Of these referrals, 1,330 were

due to DM. Holman et al (2012) have highlighted variation in the rate of amputations in England and suggested this could be due to the variation in the availability of prompt access to foot care specialist teams. The development of foot protection teams for patients with new or deteriorating ulceration is a positive change and is already making an impact as shown by Huang et al (2014).

The percentage of people with DM who will eventually require a major lower-limb amputation is low, in comparison to other possible complications. However, with the surge in obesity and the increasing numbers of people living longer, the future in regard to the potential morbidity, reduction in quality of life and mortality for those who will need amputation of a limb in the years to come is sobering, as shown by Price (2004) and Hoffstad et al (2015).

After amputation of a lower limb, many patients will be reliant on wheelchair mobility in the short and long term. The wearing of a prosthetic limb for walking requires the patient to have strength, ability to learn new skills and to be medically stable.

Davie-Smith et al (2017) have shown that walking for enjoyment among the population with vascular disease, however, should not be underestimated. The fitting rates of prosthetic limbs for walking in patients with DM varies between continents and within countries. Webster et al (2012) and Davie-Smith (2017) have demonstrated that fitting rates at 12 months for vascular patients are as high as 90% in America, whereas much lower rates are achieved in the UK, around 40%. The reason for this difference is not entirely clear, however, all figures agree that the fitting rate is lower for older patients and those with the transfemoral level of amputation. The presence of DM is not a negative predictor for prosthetic fitting as shown by Davie-Smith (2017).

Pre-amputation advice

For patients with foot ulceration, thought likely to need a major amputation, it is best practice to offer a pre-amputation consultation with the professionals in the amputee rehabilitation centre as recommended by the British Society of Rehabilitation Medicine (2018). This provides the patient with information on footcare, the likelihood of walking in the future, the need to comply with preoperative exercises, the use of a wheelchair and home adaptations. An opportunity to meet with another established amputee can be invaluable and provide hope for the future. Some patients will present through Accident and Emergency or via vascular clinics, and require urgent major amputation without the opportunity for preamputation advice.

Early amputee rehabilitation

Provision of an 'in reach' service by the amputee rehabilitation team on the vascular ward allows new patients to meet with the podiatrist, physiotherapist, occupational therapist (OT) and consultant in rehabilitation. In Northern Ireland, an in reach service has been provided weekly to the regional vascular ward and is a valuable way of engaging early with patients who have had major amputation and who will be attending the amputee centre imminently for a needs assessment. Schofield et al (2006) have highlighted that patients with a lower-limb amputation and DM have a 55% greater risk of death post-amputation than those without DM and, in addition, have a higher risk of developing

congestive cardiac failure and needing a further amputation subsequently. Therefore, it is vital that timely, appropriate rehabilitation input is provided.

Early advice can be given on the use of a wheelchair, transfers, exercises, the need for an extended period of early rehabilitation, phantom pain treatment and availability of amputee peer support. In addition, advice on pressure relief and referral to the community OT service for assessment of long-term home environmental adaptations can be made promptly. Ray (2000) indicated that patients with DM are five times more predisposed to wound infections than patients without DM and this may result in increased levels of postoperative pain and delay wound healing.

In the early postoperative period, oedema management of the residual limb is important for wound healing. For those patients without evidence of wound infection and breakdown oedema can be reduced using a shrinker sock from day 7 postoperatively, an amputee leg rest and active stump exercises. The British Association of Chartered Physiotherapists in Amputee Rehabilitation (2016) recommends that mobility postoperatively should be in a wheelchair, unless there are specified reasons to teach a patient to use crutches, zimmer frame or rollator. Hopping is strongly discouraged due to potential damage to the remaining foot and the high risk of falls.

Kanade (2006) et al have shown that transfers or walking with a prosthetic limb will naturally alter plantar pressures on the remaining foot, making it more vulnerable to ulceration. In addition, the contralateral limb will potentially have neurological and vascular disease, foot ulceration or necrosis, oedema due to immobility, cardiac, renal issues and biomechanical dysfunction. Podiatry involvement to enhance this early part of the rehabilitation process must focus on the 'back to basics' of skin protection: excellent nail, skin and wound care, alongside risk assessment, education and provision of offloading therapeutic footwear and insoles. The Contralateral Foot Pathway developed in Northern Ireland in 2008 has improved the communication between hospital and community podiatry; the community podiatrist will be alerted to the fact that the patient is now an amputee and will require ongoing footcare and education. Even simple tasks of nail cutting can have devastating consequences if incorrectly or

Key words

- Lower-limb amputation
- Multidisciplinary assessment
- Multidisciplinary rehabilitation
- Pre-amputation advice

Figure 1. A patient with a left transtibial amputation secondary to peripheral vascular disease and diabetes mellitus, standing using a Pneumatic Post Amputee Mobility Aid (PPAM) aid.



inexpertly carried out in such vulnerable feet.

Early walking aids allow patients to practice standing and walking even before a prosthesis is made. They can be used in the early postoperative period when the wound is showing good signs of healing. The Pneumatic Post Amputee Mobility Aid (PPAM aid) (Figure 1) is used for a patient with a transtibial amputation. The patient in this figure had a slowly improving stump wound prior to using the PPAM aid (Figure 2) and 5 weeks post walking with the prosthetic limb (Figure 3). The PPAM aid was used to evaluate whether or not walking could be initiated without wound deterioration and to assess if the patient would develop pain around the wound, which might halt walking training. The Femurette (Figure 4) is used for a patient with a transfemoral amputation. It has a hinged knee that locks on standing. The PPAM aid and femurette can be used as assessment tools for evaluation of how an amputee will cope with walking using a prosthesis, their stamina and learning potential. Early mobilisation with the PPAM aid may help reduce oedema, promote wound healing, improve balance, posture, exercise tolerance and



Figure 2. Appearance of the transtibial residuum wound at the start of PPAM aiding.

cardiovascular fitness, and give the amputee a positive feeling of being upright as already reported by Pollack and Kerstein (1985).

Multidisciplinary assessment

All patients with major lower-limb amputation are referred to the Amputee Rehabilitation Centre, Musgrave Park Hospital for a multidisciplinary team (MDT) assessment at 6 weeks post surgery. The British Society of Rehabilitation Medicine Amputee Guidelines (2018) state that it is best practice that all patients are assessed, even those who may not walk with a prosthesis. There is a wealth of information and experience among the rehabilitation team from which all patients may benefit. Each team member has a role and, working together, a 1-hour assessment will culminate in a decision to move forward with walking training, transfer practice, which may or may not use a prosthesis as an aid, and a trial of an early walking aid or no team intervention needed, but further community input required. The Royal College of Occupational Therapists (2011) guidelines state that the OT's focus is to enable patients to become independent in areas such as self-care, productivity, leisure and promotion of independence as a wheelchair user. The physiotherapists will assess muscle strength, joint restrictions and evaluate the patient's general strength. The prosthetist during the assessment will accrue information on the level of previous activity, hobbies and physical fitness. The rehabilitation consultant will evaluate the general medical health, cardiovascular and respiratory reserve, advise on treatment for nerve and nociceptive pain and provide an overview to the patient of the team's options for input. It should be



Figure 3. Appearance of the transtibial residuum wound 5 weeks after completing walking training with the prosthesis.



Figure 4. A patient with a left transfemoral amputation secondary to peripheral vascular disease and diabetes mellitus, standing using a femurette.

remembered that there is a high incidence of occult coronary artery disease in patients with DM; some studies have found this as high as 42%. Therefore, a baseline electrocardiograph and careful monitoring of vitals in the early walking phase especially is important (Zellweger et al, 2004). Overall, the objective is to maximise the patient's function and mobility, whether they proceed to use a prosthesis or not.

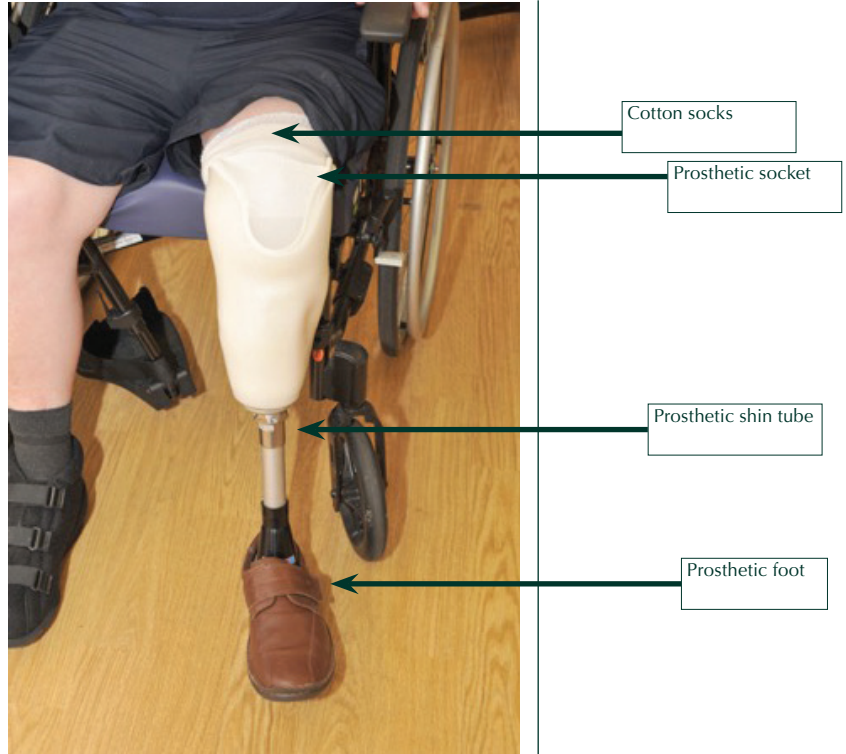


Figure 5. A patella tendon bearing prosthetic limb.

The prescription of a prosthetic limb requires consideration of the most appropriate componentry to maximise patient safety, stability and ease of donning and doffing. Key prosthetic goals are patient socket comfort, reduction of the risk of skin breakdown and good walking stability. Lack of sensation and poor skin integrity predisposes to sores and infection in patients with diabetes, so optimal socket fit is key. Simpler prosthetic feet, such as the Solid Ankle Cushion Heel (SACH), give a stable base of support especially good for indoor walkers. Van Leeuwen et al (1990) have shown that if a patient is likely to mobilise outdoors, a prosthetic foot with ankle movement will allow for accommodation of cambers in paths and transmit less pressures to the stump. A supportive suspension system can enhance proprioception and give support to weaker muscles. Simpler components generally result in a reduction in the overall weight of the limb, ensuring the patient is able to control the prosthesis better. All prosthetic components are rated to a safe weight limit that must also be considered.

Once the volume of the stump stabilises, usually after 1 year, other types of socket incorporating



Figure 6. Patient standing with a patella tendon bearing prosthetic limb.



Figure 7. Patient standing with an ischial bearing transfemoral prosthetic limb.

liners or flexible materials inside sockets can be considered to help prevent skin breakdown. Total surface bearing sockets spread the forces transmitted to the stump, therefore, reducing the chances of skin breakdown and improving comfort. The patient in *Figure 5* is wearing a prosthesis with a prosthetic foot (Multiflex, Blatchford), which allows some ankle movement and uses supracondylar suspension over the femoral condyles. The multiflex prosthesis is a foot component specifically chosen for this patient to provide stability but also some degree of plantar flexion and dorsiflexion at the ankle area. This should make outside walking more comfortable for the patient.

For transfemoral dysvascular amputees who have the skills to walk, often a locked prosthetic knee will give improved stability and confidence (*Figure 6*). Some patients may be able to utilise a free knee, which will bend in the swing phase and allowing a more natural gait. Walking with a transfemoral prosthesis compared to a transtibial prosthesis requires almost twice as much energy.

Patients who proceed with prosthetic training will focus on goals such as transfers with the prosthesis

on, toileting, dressing, domestic activities, leisure interests and getting back to work. Fatigue, coping skills and safety awareness can be problematic during rehabilitation. A cognitive assessment can help steer discussion with the patient and family when progress is slow. Facilitating access to the driving assessor and returning to driving post amputation are common aims for patients.

Training for walking includes standing balance and posture, weight transference exercises and walking between parallel bars using verbal cues and mirrors for visual feedback. Correct foot placement, step length and even timing are essential. Focus is on symmetry, posture during gait and progression to appropriate walking aids supervised and then independently. The correct walking aid in the early stages is important to prevent common overuse injuries, strain in the contralateral limb, reduce falls risk and future low back pain as shown by Gailey et al (2008) and Gaunaud et al (2011). A new prosthetic limb wearer may have an unstable weight bearing contralateral foot, with a wider base of gait to aid balance. This may create new moisture or pressure on a nail border or retracted

toe, in a swollen foot often within a poorly fitting shoe. Rapid deterioration in the contralateral foot can ensue in an already circulatory compromised limb. Bespoke offloading insoles to cradle the foot within temporary footwear and accommodate dressings may be needed.

For patients who will not be using a prosthesis the thrust of the advice and therapy will be to keep them physically strong, free from joint contractures, foot damage and to facilitate independence as a wheelchair user. Ability to learn sliding transfers and avoid the need for a hoist will allow the patient to maintain core strength and avail of car transfers.

Conclusion

The multidisciplinary rehabilitation of patients with DM who have undergone a major amputation results in achievements for the patients and restoration of some normality to their life. Occult cardiac disease, increased risk of wound infection and increased post operative mortality in this group requires high quality care by the whole team.

Irrespective of whether a patient with an amputation will walk again or not there needs to be greater awareness by each patient and healthcare professional of the ongoing issues in the most vulnerable remaining contralateral limb. ■

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