Third Edition 2020

Recommendations Document

Evidence based clinical guidelines for the physiotherapy management of adults with lower limb prostheses

British Association of Chartered
Physiotherapists in Amputee Rehabilitation

BACPAR

Evidence based clinical guidelines for the physiotherapy management of adults with lower limb prostheses

About this document: This document describes the evidence based clinical recommendations for best physiotherapy management of adults with lower limb prostheses as described in the literature and expert opinion.

This document will update: Broomhead P, Clark K, Dawes D, Hale C, Lambert A, Quinlivan D, Randell T, Shepherd R, Withpetersen J. (2012) *Evidence Based Clinical Guidelines for the Managements of Adults with Lower Limb Prostheses*, 2nd Edition. Chartered Society of Physiotherapy: London.

Please refer to the guideline process document for full details of all methodology and processes undertaken in the development of these recommendations. All appendices referred to will be found in the process document.

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Introduction

This third edition seeks to integrate new scientific evidence and current best practice into the original recommendations using similar methodology.

These guidelines are not mandatory and BACPAR recognise that local resources, clinician enthusiasm and effort, support from higher management, as well as the rehabilitation environment in which the practitioner works, will influence the ability to implement recommendations into clinical practice.

CPD activities:
Examples of CPD activities and evidence can be found at Health Professions Council (2017) Continuing Professional Development and your registration [14] https://www.hcpc-uk.org/globalassets/resources/guidance/continuing-professional-development-and-your-registration.pdf

Guidelines Recommendations
These guidelines are divided into 6 sections for ease of reference:

- The Multidisciplinary Team;
- Prosthetic Knowledge;
- Assessment;
- The Prosthetic Rehabilitation Programme;
- Patient Education;
- Discharge, Maintenance and Participation.

It was agreed by the Guidelines update group (GUG) that the six section headings utilised in the previous editions remained clinically relevant and representative of the evidence. After the literature search was completed, it was discussed that the last title should change from "Discharge, maintenance and long term needs", replacing "long term needs" with "participation". This is to reflect the increasing amount of evidence for amputees participating in not only sport and physical activity, but also social and daily living activities to enhance quality of life.

Each section includes an introduction, a summary of the evidence, the relevant recommendations, good practice points (GPPs) and suggestions for local implementation. Throughout these sections, adults with lower limb prostheses may be referred to as individuals, amputees, patients or users.

Recommendations were developed and graded according to the level of evidence (Appendix 7). After each recommendation, the letter in brackets refers to the evidence grade allocated (Appendix 8). Where a number of different evidence sources were used to develop a recommendation, the grade is based on the highest level of evidence used. This grade reflects the quality of the evidence reviewed and should not be interpreted as the recommendation's clinical importance.

The table of the papers utilised in developing the recommendations, and their allocated level of evidence, is in Appendix 9. The full list of references follows the recommendations.

Key to the Guidelines Update:
Where recommendations have been amended or added to, update symbols are displayed next to the recommendation numbering for ease of identification:

- New recommendations/GPPs in these guidelines update are marked **
- Amended recommendations/GPPs are marked ~~

Section 1: The Multidisciplinary Team

Introduction

A specialist multidisciplinary team (MDT) achieves the best prosthetic outcomes [46,47]. The amputee is the central member of the team and, with the carer, should be involved with all decision-making [3]. Working together towards goals agreed with the individual prosthesis user, the physiotherapist plays a key role in coordinating patient rehabilitation [51,52].

CSP Physiotherapy Quality Assurance Standards [3] outline the role of the physiotherapist within a MDT. These standards emphasise the need for physiotherapists to be aware of the roles of other members of the MDT and to have clear protocols and channels of referral and communication between members.

For amputee rehabilitation, the core MDT may include specialist physiotherapists, occupational therapists, prosthetists, rehabilitation doctors, counsellors and nurses [4].

Additional MDT members can include individuals from: the diabetic team, dieticians, general practitioners, housing & adaptation officers, orthotists, podiatrists, psychologists, the social services team, social workers, surgeons, the ward team, the wheelchair services team, community physiotherapists and pain control specialists; their involvement will depend upon the patient's specific rehabilitation needs and circumstances.

Evidence

The MDT approach to amputee rehabilitation is recognised internationally as the rehabilitation model of choice; however, there is little published literature to support it.

Two case-control studies by Ham et al. [51, 52] suggested that vascular amputees benefit from care by a specialist MDT with reduced hospital stay, reduced outpatient re-attendance and increased use of the prosthesis. However, these results are inconclusive as numbers in the first study were low, the second study sample was not representative of the population under investigation and the results were incomplete due to changes in staff during the follow-up period. In 1997, Pernot et al. [53], in a non-systematic overview of 71 studies concerning predictive or prognostic factors for functioning with a prosthesis, advocated that a specialist rehabilitation team must lead rehabilitation.

In the absence of other evidence, it was agreed that the physiotherapist further contributes to the MDT in relation to audit, research and education [1].

Recommendations

1.1 A physiotherapist specialising in amputee rehabilitation (Appendix 14) should be responsible for the management of physiotherapy care. (B) [51-53]

Good Practice Points (GPPs)

****GPP I** – the physiotherapist should encourage and facilitate the patient to take a self-management approach throughout their rehabilitation.

****GPP II** – the physiotherapist should be aware of the referral pathways to the wider MDT/Stakeholders relevant to the holistic care of an amputee.

~~ GPP III - the physiotherapist should contribute to MDT audit, research and/or education, where possible.

Local Implementation

- The MDT should agree its approach to the rehabilitation process to holistically identify and address the prosthesis users' ongoing biopsychosocial needs.
- Local service standards should be agreed which reflect the recommendations of this and other published professional guidelines pertaining to the prosthetic rehabilitation of adult lower limb amputees [4,5,6].
- Channels of communication and opportunities for clinician education and discussion should be established.
- A format for MDT documentation should be agreed.
- Annual targets for education, audit and research should be set.
- Integrated care pathways should be used.
- Contact details of MDT members should be readily available to the patient and carers.

Section 2: Prosthetic Knowledge

Introduction

It is essential for the physiotherapist to have an understanding of prosthetic design, componentry and function to facilitate rehabilitation and to ensure safe use of the prosthesis at all times [15].

The physiotherapist is responsible for keeping up to date with advances in prosthetic technology [15] and identifying/ addressing personal learning needs in order to maintain safe and effective clinical practice [3].

To provide an efficient, patient-centred service, the physiotherapist should maintain a close liaison with the patient's named prosthetist, at the prosthetic centre, as well as other MDT members.

Evidence

Five studies (1 cohort, 3 case-control and a case series) looked at a variety of patients from healthy fit young males to elderly or arthritic amputees with differing levels of amputation. All of the studies suggested that understanding gait mechanics, as well as the physiological and prosthetic factors affecting gait, promotes greater independence and increased functional status [54-59]. The variation in design, quality, participants and prosthetics practice in these studies meant that little evidence was available to determine the effect of the physiotherapists' knowledge and understanding of prosthetics on the outcome of rehabilitation. The Delphi technique was used to gain consensus opinion.

Consensus opinion among physiotherapists suggests that, with their detailed knowledge of the patient's physical potential, motivation and componentry, the physiotherapist has a valuable contribution to make to the MDT decision-making process regarding prosthetic prescription.

Good Practice Points (GPPs)

GPP IV: The physiotherapist should understand the different methods of donning and doffing prostheses.

GPP V: The prosthetic centre should be contacted if there is malfunction of any componentry.

GPP VI: The prosthetic centre should be contacted if the socket requires adjustment in order to achieve a correct and comfortable fit.

Recommendations

2.1 The physiotherapist should understand the theory of prosthetics componentry and the effects of prosthetic rehabilitation on the remaining body systems. (B) [54-59]

2.2 To provide effective gait re-education, the physiotherapist should understand the principles of physiological and prosthetic gait and the factors (both physical and biomechanical) that affect them. (A) [55,56,57,59]

2.3 The effects of prosthetic alignment on pressure distribution within the socket should be understood. (C) [59]

2.4 ~~ The management of residual limb volume changes in relation to socket fit should be understood. (B) [8,60]

2.5 The physiotherapist should understand the pressure tolerant and pressure sensitive areas of the residual limb in relation to prosthetic fit. (D) [15]

2.6 The physiotherapist should check the prosthesis for correct and comfortable fit prior to each treatment, until the patient (+/- their carer) is able to do this for him/herself. (D) [15]

2.7 The physiotherapist should examine the residual limb before and after use of the prosthesis, until the patient (+/- their carer) is able to do this for him/herself. (D) [15]

2.8 The patient (+/- their carer) should examine the residual limb before and after use of the prosthesis. (D) [15]

2.9 ~~ The physiotherapist should contribute to the decision-making process regarding both prosthetics provision and prescription, taking into account specific assessment findings such as the patient's musculoskeletal function, cognition and exercise tolerance. (D) [3,15]

Local Implementation

- Agreed procedures for communicating with the local prosthetic centre should exist if the patient is receiving physiotherapy treatment elsewhere.
- Agreed criteria for the issue of prostheses should be available.
- There should be opportunities for CPD and lifelong learning.
- The review of 'Prosthetic Best Practice Guidelines' [6] may be one resource that assists the physiotherapist in identifying and addressing their own specific prosthetic learning needs.

Section 3: Assessment

Introduction

Sufficient information should be gathered at the initial assessment to enable shared decision-making about prosthetics provision. Realistic goals can then be set and a rehabilitation programme agreed with the patient, with or without a prosthesis [4]. 'Shared decision-making' is a key recommendation in the 2010 White paper – Equality & Excellence: Liberating the NHS [12] – which emphasises the concept 'no decision about me without me'.

The physiotherapy assessment should include a subjective and objective examination, and should consider social situation, home environment, emotional and cognitive status. Assessments should apply a holistic approach and include both lower limbs, trunk and upper limbs. Included in the assessment should be diabetic status, skin condition, sensation (upper and lower limbs) and the presence of oedema.

Due to the expected change in functional level as a result of rehabilitation, a relevant and validated outcome measure should be used and recorded to evaluate change. Tools are available to assist this process and to track progress throughout the rehabilitation programme [61-63].

Evidence

Relevant studies to this section were found, but the quality of these studies was generally poor (details of study designs, etc. are given in the table of included studies in Appendix 9). The available information highlighted the need for a holistic approach when assessing patients with lower limb prostheses. No contradictory evidence was found.

Most of the references investigated factors that affect function. Grieve et al. [26], in a small case series with inadequate follow-up, showed that following amputation patients experienced lower levels of function compared to "normals". In addition, those patients with diabetes were more likely to experience functional difficulties. Sions et al. [64], using research-grade accelerometers, demonstrated in a study of 47 highly functioning unilateral transtibial amputees that even this highly active group, had a step count that was 49%-68% of able-bodied adults. Activity levels were further influenced by age, balance confidence and prosthetic functional use.

Klenow et al. [65] conducted a systematic literature review about exercise testing as a predictor of successful ambulation with a lower limb prosthesis and included 10 articles. The authors were able to generate 6 empirical evidence statements with grade A research recommendations. They pointed out that their clinical practice guideline should only be used when there was "reasonable concern" of cardiopulmonary impairment or compromise, and that patients who did not reach their recommended levels of cardiorespiratory fitness should be provided with ongoing rehabilitation and reassessment.

Falls are a well-known phenomenon in the lower limb amputee population [66]. Undertaking a falls risk profile should be a core element of the initial assessment process in order to mitigate risk [67].

Wan Hamzy et al. [68] conducted a small cross-sectional survey (n=30) which found that the presence of diabetes and related diabetic co-morbidities can lead to sub-optimal use of a prosthesis; there is, however, limited scope to generalise their results due to subject recruitment issues and significant cultural differences regarding prosthetic provision between Malaysian and UK practice.

Van de Ven in 1981 [70] highlighted the importance of environmental factors in determining mobility in a cohort study of 96 bilateral amputees; they felt this could explain deterioration in mobility outside the clinical setting. In 1992, Collin et al. [69] reported the results of a retrospective case series looking at patients using a wheelchair following bilateral amputation. They emphasised that functional outcome can be affected by the environment into which the patient was discharged. Later, in 1995, Collin et al. [27] concluded, from a case series of poorly defined elderly individuals, that this patient population will be less mobile following a lower limb amputation so a wheelchair should be routinely provided.

Studies that gave evidence supporting the need to examine specific pathologies include a cohort study by Potter et al. [71]. They noted that in patients with diabetes, peripheral neuropathy is nearly always present in the intact limb and that it is also present in two thirds of non-diabetics. This demonstrates the need to ensure sensation is routinely checked during assessments. The importance of skin checks is reinforced by the cohort study carried out by Levy in 1995 [60] who investigated the skin problems associated with wearing a prosthesis. However, the participants in this study were not well defined and it was not possible to tell if the follow-up of the subjects was adequate.

Nicholas et al., in a case series of 94 amputees [23], and Waters et al. [58], in a case-control study, found that the higher the level of amputation, the greater the negative influence in respect to job retention and energy cost of walking, respectively.

Hanspal et al. [72] found impaired cognitive skills to negatively affect functional outcome with a prosthesis in a retrospective case series, where no adjustment had been made for other prognostic factors. Later papers [73,74] suggest that the results of a cognitive assessment on elderly patients soon after amputation can predict the level of mobility likely to be achieved after 6 months. More recently Sansom [75] found a predictive relationship between executive performance and walking ability. Frengopoulos et al. [76] used a battery of tests, including the Montreal Cognitive Assessment (MOCA), and found there is a relationship between cognition and functional outcomes; they concluded however, that these patients should not necessarily be excluded from rehabilitation as outcomes are multifactorial.

In a retrospective case series of patients with hemiplegia and dysvascular lower limb amputation, Altner et al. [77] reported that neuromuscular status was the only significant factor affecting ambulation in patients. Furthermore, Brunelli [78] demonstrated worsening prosthetic function and increased abandonment in a cohort of contralateral hemiplegic patients.

There was often only one study for each prognostic factor investigated, making it difficult to draw any conclusions based on the evidence available at present.

The CSP Quality Assurance Standards [3] state that:
'An appropriate measure is used to evaluate the effect of physiotherapeutic intervention(s); and the measure chosen is published, standardised, valid, reliable and responsive.'
(Quality Assurance Standard 9.4.2.1.)

Condie et al. [79] performed a systematic review of the literature (1995- 2005) pertaining to prosthetic outcome measures. They identified a vast number being utilised within the literature but concluded that at the time there was no 'Gold Standard' outcome measure. They suggested that mobility, function and quality of life should be measured by the prosthetic MDT using validated measures but acknowledged that more than one measure may need to be applied to obtain this information.

Resnik [80] provided a systematic review of community integration measures and recommended several self-report tools, such as the Trinity Amputation and Prosthesis Experience (TAPES). Some of the measures are currently not routinely used in clinical practice in the UK. The updated BACPAR outcomes tool box [81] contains multiple validated performance-based outcome measures for the adult lower limb amputee population which are more frequently implemented into clinical practice.

Good Practice Points (GPPs)

** **GPP VII**: The physiotherapist should be involved in the assessment and decision-making process around the provision of the prosthesis.

** **GPP VIII**: The rationale and clinical reasoning for prosthetic provision should be documented.

GPP IX: The physiotherapist should be aware of the prosthetic componentry, type of socket and method of suspension being utilised and this information should be documented within the patient's notes.

Recommendations

3.1 ~~There should be written evidence of a full physical examination and assessment of previous and present function, including cardiovascular status. (A) [23,26,27,56,58,60,65,71]

3.2 **An assessment of falls risk should be documented. [67]

3.3 ~~The patient's social situation, psychological status, goals and expectations should be documented. (B) [23,26,27,69,70,72-76]

3.4 ~~Relevant pathology including diabetes, impaired cognition and hemiplegia should be noted. (C) [54,60,71-74,78]

3.5 A problem list and treatment plan, including agreed goals, should be formulated in partnership with the patient. (D) [23]

3.6 ~~There should be evidence of the prosthetic MDT applying valid, reliable and responsive outcome measures to collect baseline data for each patient during the assessment period and using these data to inform subsequent treatment programmes. (B) [61-64,66,79,81,82]

Local Implementation

- A locally agreed physiotherapy assessment form should be used.
- Names and contact details of the MDT involved in the patient's care should be recorded to facilitate communication.
- There should be local agreement as to the outcome measure(s) which will be utilised within clinical practice and the timescales over which they will be applied and retested.
- There should be a locally agreed protocol to follow should any patient's comorbidities result in a clinical emergency e.g. diabetic hypoglycaemia, cardiac arrest.

Section 4: The Prosthetic Rehabilitation Programme

Introduction

The aim of prosthetic rehabilitation is to achieve maximum independence, safely and with minimum extra energy expenditure. The individual's rehabilitation programme should consider their pre-amputation lifestyle, expectations and medical limitations.

The level of amputation, physical and psychological presentation and social environment influence the expected level of functional independence. The physiotherapist progresses the patient through a programme based on continuous assessment and evaluation. Through regular assessment, the physiotherapist should identify when the individual has achieved optimum function with a prosthesis, facilitating discharge to a maintenance programme [3].

An alternative method of mobility is necessary when the prosthesis is not being worn; what is selected will depend upon the physiotherapist's assessment of the patient's physical ability, risk factors (especially regarding the status of the contralateral leg) and the environment in which they will be mobilising.

Evidence

There are many physical factors influencing prosthetic rehabilitation and its outcomes. Many of these are modifiable factors – muscle strength, the ability to generate force, small lever arms and altered gait mechanics, physical strength, postural control and balance, metabolic efficiency and joint range of motion – making them amenable to physiotherapeutic intervention [71,83-90].

All applications of physiotherapy methods mentioned in a review by Ulger et al. [86] had positive effects on functional status. Application of physiotherapy rehabilitation with a suitable prosthesis as early as possible was found to have a significant effect on functional restoration, and was accompanied by decreased energy consumption, improved balance, and normalisation of gait patterns. Support for early intervention is further evidenced by the work of Fajardo-Martos et al. [91].

Two studies examining the impact of Early Walking Aids (EWAs) upon prosthetic gait and function were identified. Van Ross et al. [92] conducted a case series study (n=56) examining the effects of early mobilisation, utilising the Pneumatic Post-Amputation Mobility aid (PPAM aid) and definitive prosthesis, on unhealed, dysvascular transtibial residual limbs. They concluded that the presence of unhealed wounds was not an absolute contraindication to progressing with full weight bearing mobility training. Despite this promising initial work, and the presence of very specific wound monitoring protocols, the competency skill set required and the prolonged follow-up of patients will affect reproducibility of this regime (especially in rehabilitation settings outside of prosthetic centres) and therefore a recommendation cannot be currently drawn from this work. In 2009, Barnett et al. [93] examined the use of PPAM aid and Amputee Mobility Aid (AMA) on transtibial amputees and found no clear advantage of using either EWA as the most significant gait adaptations occurred after prosthetic delivery. No statistically significant differences in the level of measured walking ability and quality of life were noted between the groups at discharge from physiotherapy.

Miller et al. [94] commented that patients who undergo amputation due to peripheral vascular disease are likely to display weakness and generalised deconditioning secondary to a sedentary lifestyle.

Ozyuric et al. [95] found weak knee extensors in 12 transtibial patients, one third of whom were dysvascular patients, when testing sit to stand techniques. These patients also exhibited increased loading of the residual limb and increased sway. A systematic review by Prinsen et al. [96] described prosthesis users as having gait adaption strategies that rely on hip extensors to compensate for a loss of sensorimotor function in both the amputated and residual lower limbs. They suggested emphasis should be placed on these muscle groups during rehabilitation to allow maximal adaptability. They noted, however, that their findings were limited by the generally low methodological quality and reliance on traumatic amputees for included studies.

Three studies, all using small participant numbers [56,93,97], are more explicit in recommending that specific muscle strengthening for the amputated and contralateral side and additional exercises to increase muscle strength and joint mobility of the lower limbs be instigated within an individual's prosthetic rehabilitation programme.

Pauley et al. [85] have shown hip strengthening High intensity interval training (HITT) to be successful for improving strength, balance performance (as measured with the ABC scale) and functional prosthetic use (Houghton scale) in a well-designed study.

A semi-structured questionnaire (n=202) established a significantly higher incidence of low back pain (LBP) in traumatic amputee prosthesis users within one UK prosthetic centre's catchment area compared to individuals without limb loss [98].

Trans femoral amputees were found to be more likely than transtibial amputees to suffer from back pain (81% vs. 62%) but the analysis of the underlying aetiology of the amputees' LBP should be interpreted with caution as funding limitations allowed only small participant numbers to undergo the MRI scanning. It has been hypothesised that iliopsoas dysfunction may play a role in the incidence of LBP in amputees [98, 99] but methodological limitations mean that further research involving larger cohorts is required before specific recommendations can be made.

Gailey et al. [99] concluded that 'quality' prosthetic care could be important in the prevention of secondary musculoskeletal issues, but this study did not include an operational definition of 'quality'. It is outside the scope of these guidelines to attempt to establish what constitutes best prosthetic practice.

Case control studies suggest [56,100-104] that functional skills of

increasing complexity should be taught within the patient's limits.

Consensus opinion [15] was sought to determine and detail the specific more complex tasks that may be taught, depending on the patient's ability and personal goals. There was strong agreement for the activities listed in Recommendation 4.15, though teaching the use of public transport and escalators was qualified by many respondents as being desirable but impractical due to time and resource constraints.

The consensus opinion [15] was that the physiotherapist should contribute to the management of wounds, scars, residual limb pain, phantom pain and sensation together with other members of the MDT. These recommendations caused the greatest controversy in the Delphi questionnaire (Appendix 10) with some respondents highlighting that not all physiotherapists have the clinical expertise to safely input into the specified areas of a patient's care. It is therefore essential that physiotherapists only work within the scope of their own competency and work to identify their personal learning needs as per CSP Quality Assurance Standards [3]. This further highlights the need for close collaborative working within the MDT.

Three studies [105-107] examined the return to work of adults post amputation. One literature review identified 31 studies that focused on the reintegration of lower limb amputees to work but identified that the poor control of variables and differing inclusion criteria made meta-analysis and comparison of the studies difficult.

Recommendations

4.1.1 **Prosthetic rehabilitation should aim to commence as soon as possible, to optimise clinical outcomes. (B) [86,91]

4.1.2 Prosthetic rehabilitation should begin within a maximum of five working days after receipt of the prosthesis. (D)[15]

4.2 Prosthetic rehabilitation should aim to establish an energy efficient gait based on normal physiological walking patterns. (A) [58,59,83,108,109]

4.3 The physiotherapist should be aware that level of amputation, pre-existing medical conditions and social environment will affect rehabilitation. (A) [26,69-71,73,109-114]

4.4 ~~During rehabilitation the physiotherapist should take into account that gait with a prosthesis demands higher energy expenditure than physiological gait. (C) [58,84,87]

4.5 ~~The physiotherapist should prescribe a personalised exercise programme incorporating specific muscle strengthening and stretching exercises and maintaining/ improving joint mobility. (A) [56,93,96,97]

4.6 **The physiotherapist should identify altered movement strategies and teach efficient control of the prosthesis through postural control, weight transferring, use of proprioception, mental practice and exercise to prevent and correct movement deviations where possible. (B) [95,100-103,113,115]

4.7 The physiotherapist should be aware of the incidence of LBP amongst prosthesis users and work alongside the prosthetic MDT to optimise prosthetic alignment, fit and minimise postural asymmetries. (C) [98,99,116]

4.8 During prosthetic rehabilitation, patients should receive physiotherapy as often as their needs and circumstances dictate. (D) [15]

4.9 The prosthesis should be worn for short periods of time initially, increasing in use as exercise and skin tolerance allow. (D) [60]

4.10 Gait re-education should commence within the parallel bars unless there are specified reasons documented for utilising alternative strategies. (D) [15]

4.11 Gait re-education should progress through walking within a supported rehabilitation setting to walking within the home environment. (D) [15]

4.12 Walking aids should be provided to ensure that prosthesis users, where possible, progress to being fully weight bearing through their prosthesis. (D) [15]

4.13 Functional skills progressing in complexity should be taught within the patient's limits. (B) [56,100-106,115]

4.14 Rehabilitation should be functional and integrated with activities of daily living. (D) [15,117]

4.15 ~~Where possible, the physiotherapist should instruct the patient in a range of functional tasks which are both:
i) relevant to the goals set with that individual, seeking to improve their community participation. [118]
ii) deemed by the physiotherapist as being within the patient's physical capabilities to safely undertake a trial of the task.
These activities may include:
- mental practice; [119]
- getting up from floor; [117]
- sit to stand; [95,117]
- obstacle crossing; (C) [120]
- getting in and out of a car;
- going up and down stairs [121], kerbs, ramps and slopes;
- walking in a crowded environment;
- carrying an object whilst walking;
- walking over uneven ground outdoors;
- changing speed and direction;
- picking up objects from the floor;
- opening and closing a door;
- using public transport;
- the use of escalators. (D) [15]

4.16 ~~Prosthesis users should be encouraged and assisted to participate in hobbies, sports, social activities and driving. (C) [70, 115,122]

4.17 **Where applicable, prosthesis users should be encouraged and assisted to return to work. (B) [107,125,126]

4.18 ~~Prosthesis users' progress should be measured using outcome measures validated for lower limb amputees throughout the rehabilitation programme. (B) [79,81]

4.19 ~~The physiotherapist, alongside the MDT, should contribute to the management of wounds during rehabilitation. (D) [15]

4.20 ~~The physiotherapist, alongside the MDT, should contribute to scar management during rehabilitation. (D) [15]

4.21 The physiotherapist, alongside the MDT, should contribute to the management of residual limb pain. (D) [15]

4.22 The physiotherapist, alongside the MDT, should contribute to the management of phantom sensation/pain. (D) [15]

Good Practice Points (GPPs)

GPP X: Where a prosthesis is provided for transfers only (or to assist with nursing care), the physiotherapist should give instructions and advice on its safe use.

Local Implementation

- Resources, including staffing, and facilities that allow full functional rehabilitation, are necessary and may act as barriers to achieving the recommendations within these guidelines.
- Local protocols should be referred to or developed to cover specific treatment modalities.
- There should be local agreement as to the outcome measures selected and the timescales over which they will be applied and retested. The BACPAR endorsed 'Toolbox of Outcome Measures' [81] may be a useful document to assist the MDT in this process.
- Patients receiving cosmetic limbs (i.e., those who do not undertake any element of weight bearing through their prosthesis) will require instruction and guidance regarding its use and care. Local protocols should be developed to cover which MDT member will provide this input.

Section 5: Patient Education

Introduction

The rehabilitation process should have an educational element that empowers patients and their carers to take an active role in their present and future management of living with a prosthesis. This will assist with problem solving, particularly within normal social situations and allow them to develop an awareness of when to seek professional help.

Due to the number of recommendations in this section it has been sub-divided into six sections for ease of use. These sub-sections are:

5.1 Use of a prosthesis
5.2 Care of the residual limb
5.3 Care of the remaining limb
5.4 Informed goal setting
5.5 Coping strategies following falls
5.6 Further information

Depending upon the environment in which the prosthetic rehabilitation is being undertaken, other MDT members (aside from the physiotherapist) may lead/contribute to the achievement of the guidelines recommendations. Where there is overlap of professional roles, local agreement should exist as to which MDT member will lead patient care; this will help to avoid unnecessary duplication, and where possible, allow effective and efficient service delivery.

5.1 Use of the prosthesis

Evidence

The Delphi process [15] was used to provide evidence and develop recommendations for this section as the literature search found no relevant references.

Recommendations

5.1.1 Patients/carers should be given information about the prosthesis, its functions and limitations. (D)[15]

5.1.2 Patients/carers should be given information regarding the care of their prosthesis. (D) [15]

5.1.3 Patients/carers should be given instruction on achieving correct socket fit, considering pressure tolerant and pressure sensitive areas of their residual limb. (D) [15]

5.1.4 Fluctuations in residual limb volume and its management should be explained. (D) [15]

5.1.5 Guidance should be given on the length of time the prosthesis should be worn and how this should be increased. (D) [15]

5.1.6 An explanation should be given on how changing footwear may alter prosthetic alignment and the distribution of pressure within the socket. (D) [10]

5.1.7 ~~The patient/carer should receive instruction in the use and care of prosthetic socks and liners and be able to demonstrate their use. (D) [15]

5.1.8 Instruction should be given in the correct use of the type of suspension used. (D) [15]

Local Implementation:

- The physiotherapist needs to ensure that all information given by the physiotherapy team is accurate and complements the advice and information given by other members of the prosthetic MDT.
- Where there is overlap of professional roles, local agreement should exist as to which MDT member will lead specific aspects of patient care.
- A locally agreed system should be in place regarding the provision of a wheelchair for patients during times when they are unable to use their prosthesis.

5.2 Care of the residual limb

Evidence

In 1995, Levy et al. [60] found a number of skin problems associated with wearing a prosthesis in a cohort study with an undisclosed number of patients. The causative factors included those created by poorly fitting sockets, for example, mechanical rubs, excessive negative pressure in suction sockets, excessive heat or other anatomical or physiological problems such as adherent scars, uncontrolled diabetes and poor hygiene. The effect on the skin due to these factors was varied and oedema, epidermoid cysts, abscesses, infection and fungal infections were all reported. The authors suggested pads, compression bandages, gels, shrinker socks and improved socket fit play an important role in resolving these problems. Due to the lack of details about the participants in this study, and in the absence of further literature evidence, consensus opinion was sought to further inform this section.

Recommendations

5.2.1 Techniques for the self-management of phantom pain/ sensation should be taught.(D)[15]

5.2.2 Advice should be given to the patient/carer on the factors influencing wound healing.(D)[15]

5.2.3 Instruction should be given to the patient/carer on methods to prevent and treat scar adhesion.(D)[15]

5.2.4 ~~Information should be given about skin care of the residual limb, sweat management and the potential problems related to poor hygiene, inadequate or overzealous skin care.(D)[60]

5.2.5 Patients/carers should be informed that ill-fitting sockets, for whatever reason, can cause skin problems. (D)[15]

5.3 Care of the remaining limb

Evidence

Potter et al. [71], in a cohort study of 80 patients with unilateral amputation due to diabetes, found peripheral neuropathy to be nearly always present in the remaining limb. In addition, two thirds of non-diabetic, non-traumatic, unilateral amputees were found to have peripheral neuropathy in their remaining limb. A cohort study by Jayatunga et al. [127], with no control group, found patients with a unilateral transtibial amputation due to diabetes were subject to abnormal loading on the remaining foot. Careful monitoring of the remaining foot and early orthotic referral were recommended, as foot orthoses and appropriate footwear significantly reduced these forces in the study participants. In the absence of further literature evidence consensus opinion has been sought to further inform this sub-section.

Recommendations

5.3.1 The patient/carer should be taught to monitor the condition of the remaining limb. (D)[15]

5.3.2 Vascular and diabetic patients,and their carers, should be made aware of the risks to their remaining foot and educated in how they can reduce them. (A) [60,73]

Good Practice Points (GPPs)

~~GPP XI: Physiotherapists should establish links with their local diabetic foot/podiatry/chiropody services to ensure that information and education given to patients and carers is accurate and consistent.

**** GPP XII:** where the patient has received education/information, the physiotherapist should check that they can demonstrate the recommendation correctly.

Local implementation:

- The BACPAR endorsed evidence based guideline '*Risks to the contra-lateral foot of unilateral lower limb amputees: A therapist's guide to identification and management'* [9] may help guide the clinician as to the recommended areas a therapy assessment of the remaining foot should cover.

5.4 Informed goal setting

Evidence

Nine studies of mixed design and generally poor quality were found to inform this topic. Most studies examined the influence of the level of amputation on the outcome. In a retrospective case series, Hubbard [128] stated there were no predictive factors for mobility levels attained other than level of amputation in patients who had amputation for peripheral vascular disease. The paper further concluded that pre-operative mobility and personal goals should be considered when evaluating the success of rehabilitation.

Two case series, by Beekman & Axtell[111] and Grieve & Lankhorst[26], both stated that, following amputation, patients will have lower levels of function than able-bodied participants. Four studies, all but one with a retrospective design [110-112,129], concluded that the lower the level of amputation, the greater the chance of succeeding with a prosthesis. Wolf et al. [113], in a retrospective case series of 18 elderly vascular patients, observed that 50% of those who had had bilateral transtibial amputations became independently mobile with a prosthesis. For patients with a unilateral amputation, as a result of either trauma or vascular disease, the energy cost of walking increased as the level of amputation increased [58]. Waters (1976) [58] concluded from their case-control study that when preservation of function is the chief concern, amputation should be at the lowest possible level.

No contradictory evidence was found.

Recommendations

5.4.1 Patients/carers should be made aware that concurrent pathologies and previous mobility affect realistic goal setting and final rehabilitation outcomes. (D) [15]

5.4.2 Patients/carers should be made aware that the level of amputation affects the expected level of function and mobility. (C) [106,110,112,113, 129]

5.4.3 Patients/carers should be made aware that they will experience lower levels of function than able-bodied individuals.(B) [25,26,111]

5.4.4 Patients/carers should be informed that the energy cost of walking with a prosthesis is related to the amputation level. (C)[58]

5.5 Coping strategies following falls

Evidence

Three articles relevant to this section were found. In 1996, Kulkarni et al. [107] reported an increased risk of falls following amputation in a cross-sectional study of 164 lower limb amputees. However, this study did not include a comparison group and gives only limited evidence. Miller & Deathe [94] examined balance confidence in 245 unilateral lower limb amputees over a two-year follow-up period and found that the incidence of falling was 52% in their study population compared to a fall rate of 32% in their control group of able-bodied community-dwelling older adults.

There was conflicting evidence regarding whether transfemoral amputees were at significantly higher risk of falling than transtibial amputees [95,107,130]. Chihuri's study [131] illustrated that an amputation at the transtibial level (of vascular origin) was in fact a predictor of falls as this group of amputees were more active than their transfemoral counterparts and consequently more at risk of falls. Wong [66] recruited a mixture of unilateral lower limb amputees at various levels and aetiologies, as well as a small number of bilateral amputees of various levels. Wong [66] reported a falls rate of 53% and found those with higher balance confidence had more falls, this suggests that people with better balance put themselves in higher risk situations. However, the authors identified multiple limitations and lack of a causal relationship from their retrospective design.

Recommendations

5.5.1 ~~All parties involved with the patient should be made aware that the risk of falling is increased following lower limb amputation. (C) [66,106,131]

5.5.2 Rehabilitation programmes should include education on preventing falls and coping strategies should a fall occur. (C) [94,106130]

5.5.3 Instructions should be given on how to get up from the floor. (C) [106]

5.5.4 Advice should be given in the event that the patient is unable to rise from the floor. (C) [106,130]

5.5.5 ~~All patients should be asked if they have experienced falls or have a fear of falling and, if indicating that they do, further therapy incorporating balance work should be undertaken. (C) [94,132]

5.5.6 ~~Where a reduction in the individual's balance confidence is observed, all of the prosthetic MDT should be made aware of the issue and further therapeutic input should be provided to address modifiable factors. (C)[94]

Local implementation:

- The NICE Falls guidelines [67] in addition to the BACPAR endorsed '*Guidance for the prevention of falls in lower limb amputees'* [7] may help guide the clinician with recommendations suggesting what a holistic falls prevention programme should encompass.

5.6 Further information

Evidence

This sub-section is supported by consensus opinion in the absence of any published literature.

Recommendations

5.6.1 Patients/carers should be made aware of the possible effects on psychological well-being following amputation and how and where to seek advice and support. (D)[15]

5.6.2 Patients/carers should be educated in how to prevent secondary disabilities that may occur as a result of prosthetic use. (D)[15]

5.6.3 Information on the following should be made accessible, where available and relevant:

- National and local amputee support and user groups;
- Health promotion (including physical activity and weight management);
- Sporting and leisure activities;
- Driving after amputation;
- Employment/training;
- Benefits;
- Access to local Social Services. (D)[15]

Good Practice Points (GPPs)

GPP XII: Patient information should be available in a format suitable to that individual.

GPP XIII: All advice/information given to the patient should be recorded.

Local implementation:

- Information on self-management as a prosthesis user should be provided.
- Patients should be given information about the appointment system at the prosthetic centre and how to access it.
- Contact details of all relevant MDT members, as well local support/user groups (for example the Limbless Association), should be supplied to patients and carers.

Section 6: Discharge, Maintenance and Participation

Introduction

Effective discharge planning is required to ensure continued use of the prosthesis once a patient has achieved their set goals or has reached a plateau in progression. Discharge and transfer reports should use accepted terminology and refer to agreed goals [3].

Reviews and open access to physiotherapy should be available to support prosthetic use; this notion of improved ease of access and promotion of self-referral is promoted within the Allied Health Professional service offer [13].

It is reasonable to expect prosthetic usage to change with time and user experience. Inevitably some prosthesis users will experience a health decline significant enough to prevent them from using or continuing to use a prosthesis. The timely reapplication of selected outcome measures should be performed to monitor prosthetic function and further rehabilitation considered if:

1 The prescribed prosthetic componentry is changed;
2 The patient's status, aspirations or goals are altered.
3 The patient has developed a new medical or musculoskeletal condition.
4 The potential for further rehabilitation is identified on review.

Evidence

No evidence was found in the literature to support how the patient's discharge from rehabilitation should be conducted or how best to maintain their independence with a prosthesis. However, studies have proposed that regular reviews, within the first 12 months following discharge from physiotherapy, can highlight the potential for prosthetic non-use [82, 133]. An initial pilot study of behavioural modification approaches has shown success in maintaining and improving some outcome measures [134].

Other groups such as Wong et al. [135] have suggested a review of clinical tests can be used to identify patients who may benefit from further rehabilitation. This group found, using regression modelling, that increased balance confidence, ability to retrieve objects from the floor, turning to look behind, and placing alternate foot on stool were most indicative of successful prosthetic use for mobility. The authors suggested these can be reviewed by clinicians easily.

Literature, such as that presented by Gailey et al. [99], would that indicate review following discharge from Physiotherapy as secondary musculoskeletal and degenerative changes can sometimes occur in traumatic amputees after injury and acute prosthetic rehabilitation. This was further supported by Lloyd et al. [136], who investigated the risk of developing OA in the knee of the intact limb, in unilateral transtibial amputees. Their results suggested that strength asymmetry has a moderate relationship with OA risk and may be used to assess gait ability and the need for rehabilitation.

It is widely discussed within the literature that chronic low back pain is a significant problem in traumatic amputees [90,98,137]. In 2005, Kulkarni et al. [98] used a semi-structured questionnaire (n=202) and established that the peak incidence of LBP amongst their cohort occurred within the first two years post amputation. Devan et al. [138] further highlighted the multifactorial nature of back pain in their traumatic cohort. Anaforoglu et al. [116] presented evidence of a back school programme for the successful treatment of LBP. It is not clear whether these findings can be extrapolated to the dysvascular amputee population.

Very high levels of support for the implementation of a review system was gained through consensus [15] although a number of respondents highlighted that available staffing and resources were barriers to employing a self-referral system in some rehabilitation settings. Support for the implementation of a review system was gained through the work of Roffman [133]. Their work has provided some evidence to identify which patient groups were most at risk of deterioration after completing the acute stage of prosthetic rehabilitation.

Gallagher [118] has demonstrated that amputees have greater restriction in community activity and Deans et al. [123] reviewed the literature and illustrated generally poor participation in physical activity and sports in lower limb amputees. Several authors [87,124,139,140] have provided evidence linking increased physical activity to enhanced community participation and improved prosthesis use. Resnik et al. [80] highlighted five outcome measures which could be helpful in measuring and monitoring community integration. One of these measures, the TAPES score, was used by Parker et al. [141] who identified an association between ambulation, mood and community integration and quality of life.

The CSP ran a campaign in 2018 (Love activity, hate exercise) which highlighted the problem of physical inactivity. The 2019 publication of the UK physical activity guidelines then followed to highlight the health benefits of increasing physical activity and participation [142]. The new guidance from the UK Chief Medical Officer states that "there is no reason to vary the guidelines according to impairment type" for disabled people. The guidelines recommend that each week, all adults should accumulate at least 150 minutes of moderate intensity activity (such as brisk walking or cycling); or 75 minutes of vigorous intensity activity (such as running); or even shorter durations of very vigorous intensity activity (such as sprinting or stair climbing); or a combination of moderate, vigorous and very vigorous intensity activity. It further advises that all adults should "*minimise sedentary behaviours by breaking up long periods of inactivity with at least light*

physical activity, aim to be physically active every day, any activity is better than none, and more is better still".

In regard to muscle strengthening, it describes that adults "*should do activities to develop or maintain strength in the major muscle groups. These could include heavy gardening, carrying heavy shopping, or resistance exercise. Muscle strengthening activities should be done at least two days a week, but any strengthening activity is better than none*."

Other authors have investigated the effects of exercise on amputees. Lin et al. [143] linked being fitter and stronger with amputees having higher functional capacity and better gait. In an RCT, Schafer et al. [132] found that a 12-week exercise programme reduced falls, even at one-year follow-up, and significantly increased walking speed in a (small) group of community-dwelling lower limb amputees.

Whereas Rowe et al. [144] demonstrated that just brisk walking was enough to increase an amputee's energy above 3 metabolic equivalents (METS) is indicative of "exercise" as suggested by the American College of Sports Medicine (ACSM).

Recommendations

6.1 **A process should exist for regular review using outcome measures within the first 12 months of discharge from regular physiotherapy. (C) [82,133]

6.2 There should be a process in place for the patient to self-refer to physiotherapy after initial rehabilitation. (D) [15]

6.3 **The patient should be educated about the ongoing benefits of physical activity, encouraged and signposted to ongoing community services. (B) [82,124,132,139,140]

6.4 ~~The physiotherapist should be aware that secondary musculoskeletal disorders (such as low back pain) can develop over time and adversely affect function with a prosthesis (C) [98,99,116, 145]

6.5 ~~Access to further assessment and treatment/intervention should be made available if an individual's circumstances change (low back pain [116, 139], medical, environmental, prosthetic, physical, return to work or sport) to determine if further rehabilitation is indicated. (D) [15]

Good Practice Points (GPPs)

GPP XIV: A summary of the patient's function and mobility, at transfer or discharge from active rehabilitation, should be documented in the treatment notes. [3]

****GPP XV:** A record of the patient's outcomes should be kept and compared with previous assessments and reviewed regularly.

GPP XVI: The prosthesis user should be provided with the necessary contact details to seek help and advice when required.

GPP XVII: If prosthesis use is discontinued during the rehabilitation programme, the reasons should be documented by the MDT.

****GPP XVIII:** If a prosthesis user requires further specialist assessments, then onwards referral should be made in a timely fashion.

Local Implementation

- Systems for patient review should exist.
- Where there is overlap of professionals' roles, local agreement should be established as to which MDT member will lead specific aspects of patient care.
- Agreed criteria should exist to guide other MDT members in referring established prosthesis users back for further specialist physiotherapy assessment.

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