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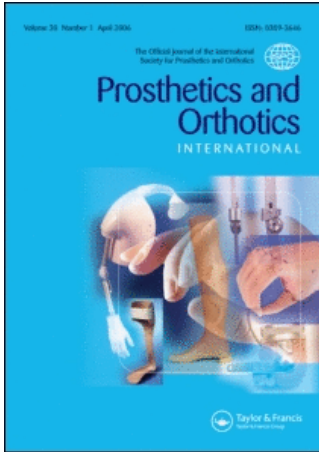
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Lower limb amputation Part 2: Rehabilitation - a 10 year literature review

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Lower limb amputation Part 2: Rehabilitation – a 10 year literature review

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Abstract

Ten years after the ISPO consensus conference on amputation surgery, a search of relevant publications in the Rehabilitation-prosthetics-literature over the years 1990-2000 was performed. The main key-words in this research were: "lower limb, amputation, human and rehabilitation". One hundred and four (104) articles were assessed by reading and from these the authors selected 24 articles. These articles are summarised, under several subheadings in this review article, focussing especially on quality of life, functional outcome and predictive factors.

Introduction

Ten years after the consensus conference of the International Society of Prosthetics and Orthotics (ISPO) on amputation surgery, held at the University of Strathclyde, Scotland in October 1990 (Murdoch *et al.*, 1992), the question was asked if the contents were still up to date especially regarding rehabilitation aspects. In the consensus report, no special chapter was focussed on rehabilitation medicine or rehabilitation management or was related to para-medical or to pre- and postoperative treatments. The ISPO consensus report is more focussed on surgical and prosthetic (technical) issues. The aim after an amputation is to bring

the patient to an optimum of physical, mental, emotional, social, vocational and economic efficiency. This treatment requires a multi-disciplinary approach. In many countries, a rehabilitation team under the supervision of a medical doctor, specialised in physical and rehabilitation medicine, will take care of this treatment. The authors were curious to know whether some new and relevant studies in the field of Rehabilitation of amputees had been published. The approach to cover the literature regarding the total management of Rehabilitation (except surgery, technical prosthetic aspects and management) is difficult because of the many issues involved in rehabilitation of an amputee.

This review should not be considered as a systematic critical review but as a personal critical review, based on literature search and the authors, own experience in this field.

Selection and methodology

The search of relevant publications in the literature over the last 10 years was performed by means of MEDLINE, EMBASE and RECAL computer programmes. Sections of mesh-headings were used. The first section contained the mesh-headings "amputation (lower limb/leg)", "human", and "rehabilitation". The second section contained the mesh-headings "pain", "psychology", "quality of life" and "treatment-outcome". Language was restricted to English, French, German and Dutch. Case reports, pilot studies and abstracts were excluded. One hundred and four (104) articles fulfilled the previously described selection

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criteria. From these a selection was made on the basis of reading the abstracts and assessing the quality of the articles in respect of the methodology used and the measurement tools. When the number of subjects described in the paper was less than 10, the paper was excluded. The article should describe a patient cohort which it should be possible to generalise to other countries and not only to the described province or local situation. Finally the selections were based on the authors' clinical and educational knowledge, resulting in 24 articles as categorised in Table 1. Most of the selected articles (15 articles) contained aspects of functional outcome and predictors regarding outcome. The authors classified these under the title "quality of life". This is preceded by a summary of 6 articles which give a general view about rehabilitation in amputees. There were no articles with new aspects regarding para-medical treatment such as physiotherapy or occupational therapy. No good articles were found which considered socio-economic, vocational or psychological aspects in relation to amputees and which could be generalised for different countries. Two (2) articles concerning phantom pain (a selection of very many articles from a separate search) and 1 concerning skin problems are discussed separately.

Literature review

General aspects

In a leading article by Collin and Collin (1995) it is written that the life expectation of vascular amputees is short; 45% die within 2 years and 75% within 4 years of amputation. For the surviving amputees rehabilitation is a necessity. The main aim of this rehabilitation

process is to restore and preserve maximum independence of actions as long as possible with the key words: independence of mobility within and outside the home. Up to 85% of the vascular amputees are fitted with a prosthesis. Only 5% of these amputees use their prosthesis for more than half of their waking hours (Collin and Collin, 1995). Within 5 years the use of the prosthesis drops from 85% to 31%. Two (2) years after amputation only 26% are walking out of doors. (McWhinnie *et al.*, 1994). The proportion of total wheelchair users rises from 13% in the first year to 39% after 5 years. Collin and Collin (1995) conclude their manuscript as follows: "The naive assumption that the ability to walk in a gymnasium 3 months after amputation constitutes the essence of successful rehabilitation will deprive many patients of full mobility from the beginning of their convalescence. Many more, who have not had environmental adaptation for a wheelchair, will become prisoners in their homes as the years go by and their ability to walk freely with a prosthetic limb is progressively lost." Jones *et al.* (1993) stated that independence in ADL is the key factor in successful return to home. Stewart and Jain (1993) found that final discharge home or to a residential home for the elderly was achieved in 76% of the patients (n=1805).

Kent and Fyfe (1999) state, in their excellent overview of prosthetic rehabilitation, that outcome measures should be selected in relation to the individual goals for rehabilitation and that the success must also be viewed in relation to the premorbid function. There is more research needed regarding the development of questionnaires which concentrate on handicap

Table 1.

Theme	Reviewed articles	Authors*
General aspects	6	Jones ('93), Stewart ('93), Collin ('95), Christensen ('95), Greive ('96) Kent ('99)
Functional outcome	9	Houghton ('92), Pell ('93), Pinzur ('93), Walker ('94), McWinnie ('94), Weaver ('96), Mueller ('97), Treweek ('98), Frykberg ('98)
Predictive factors	6	Weiss ('90), Nissen ('92), Leung ('96), Trabalessi ('98), Larsson ('98) Gauthier ('98)
Phantom pain	2	Houghton ('94), Nikolajsen ('97)
Skin problems	1	Mueller ('95)

*: only the first authors are mentioned

and quality of life issues of amputees. Only in this way, is a reasonable judgment possible of the value of rehabilitation programmes.

In close connection to the studies mentioned earlier, in a Danish study (n=29) it is concluded that there should be good communication between the professionals and the patients during the decision process concerning the provision of a prosthesis as well as the provision of complete information on the patients' future functional possibilities (Christensen *et al.*, 1995). Lack of this communication will influence the rehabilitation process negatively. Qualitative measurements must be developed in order to test the patients, prosthetic profiles to ensure a good functional rehabilitation result.

In a prospective study (n=20), it was concluded that lower limb amputees appeared to be disabled in all disability categories of the ICDH (International Classification of Impairments, Disabilities and Handicaps) and in the SIP (Sickness Impact Profile) scores (Greive and Lankhorst, 1996). In most patients functional abilities decreased after amputation and age seems to be a significant related factor. It is not clear whether age itself or whether increasing co-morbidity, diminished motivation or physical condition with age influence functional outcome. Conclusions are difficult to draw because of the small group and the heterogeneity of the patients studied.

Functional outcome

In a study of McWhinnie *et al.* (1994), 100 consecutive lower limb amputations in 96 vascular patients (mean age 74 years) were monitored. Two (2) years after amputation only 26% of the patients were walking successfully out of doors. By 5 years only 9% continued to walk out of doors with a prosthesis and an additional 8% continued to use the limb within the house.

Functional outcome in the elderly (patients 80 years of age and above; n=41) following lower limb amputation is associated with a considerable mortality (5 years survival was 25%) and deterioration of functional and residential status (Frykberg *et al.*, 1998).

Several studies were performed in relation to the cause of amputation or level of amputation. One study was done to evaluate the perception of the patient of the long-term functional outcome (on average 15 years after amputation)

after lower limb amputation following injury (Walker *et al.*, 1994). A subjective assessment of these studied amputees (n=87) implied that there was an almost similar functional outcome in trans-femoral and trans-tibial amputations (TFA, TTA). There was little functional difference between early and delayed amputations, the delayed group being more satisfied with the end result (probably due to the fact that this group have experienced some of the problems related to limb preservation). Sixty-three percent (63%) of the TFAs (n=24) used the prosthesis for more than 12 hours and 25% for 8 to 12 hours each day respectively. Eighty percent (80%) of the TTAs and 70% of the TFAs had only slight problems with walking on a flat surface. Forty-six percent (46%) of the TTAs and 42% of the TFAs had difficulties or were unable to walk on stairs. Though 60% of the TTAs and 50% of the TFAs considered themselves very or "quite" disabled.

Mueller *et al.* (1997) concluded that patients with diabetes mellitus and a transmetatarsal amputation (n=15) have considerable functional limitations, using the Sickness Impact Profile and the Physical Performance Test. Contrastingly, though with different outcome measures, in another study it was stated that a Syme amputation, is a good option in vascular patients with forefoot ischaemia instead of a TTA (Weaver *et al.*, 1996) (n=35). In this follow-up study, the cumulative ambulatory rate at 1, 2 and 5 years was 92, 80 and 80% respectively.

With the Nottingham Health Profile it was found that amputees, due to peripheral arterial disease, reported problems with mobility, social isolation, lethargy, pain, sleep and emotional disturbance compared controls to a group (Pell *et al.*, 1993) (n=149). The overall quality of life is poor, compared to a matched control group. Mobility was the only significant independent factor. Rehabilitation should therefore focus on attempts to improve mobility.

The overall success rates for rehabilitation of vascular amputees in another study is low: only 5% achieved satisfactory rehabilitation (Houghton *et al.*, 1992) (n=440).

In a retrospective (mean 3 years) multicentre study, in a selected group of TTAs due to vascular problems, the ambulatory status was high, namely 87% (Pinzur *et al.*, 1993) (n=299). By two years however, 109 (36.5%) had died.

The 87% is thus the percentage of the 299 minus 109, minus the patients who needed re-amputation (20); i.e. 170 patients. This 87% ambulatory status surpasses previous studies which is due to the patients' commitment to the rehabilitation programme, as the authors stated.

Finally in a retrospective study which involved 938 major lower limb amputees, three measures of functional outcome were compared: the Barthel Index, Russek's classification and the Locomotor Index (Trewick and Condie, 1998). Only, the Locomotor Index showed significant differences due to amputation level and age.

Predictive factors

In a prospective study a cohort of 97 amputees was followed for 15 months in order to analyse predictive factors to assess outcome (Weiss *et al.*, 1990). The amputees with extensive comorbidity were less likely to walk and the ability to perform ADL-tasks was the most important predictor for well-being and quality of life. Dependency was related also to high level of amputation, older age, confinement to an institution, presence of stump pain, confusion, and poor self-related health. The authors concluded that peri-operative screening is needed to maximise the identification of these patients.

Reintegration to normal life (RNL score) was assessed in 42 elderly (68 years; $r=42-95$ years) amputees by means of a questionnaire (Nissen *et al.*, 1992). Poor reintegration occurred in community mobility, work and recreation and it was recommended that more attention should be paid to these aspects. Only additional illness (comorbidity) showed significant reduction of the RNL score ($p<0.05$). The reason for amputation was not mentioned.

Leung *et al.* (1996) concluded in another study that the Functional Independent Measure (FIM) score at patient's admission to the hospital was not useful in predicting successful prosthetic rehabilitation in lower limb amputee patients. Only the motor subscore of the FIM at discharge correlated ($p<0.0001$) with prosthesis use. This study also confirmed that level of amputation and age were predictors in prosthetic outcome. In a prospective study on 144 patients, admitted to a rehabilitation unit for trans-femoral amputation, a study was performed to assess the relationship between nine independent

variables and a battery of outcome measures such as the Rivermead Mobility Index (RMI) and the Barthel Index (BI), effectiveness on discharge and length of hospital stay (Trabalessi *et al.*, 1998). Advanced age was the most powerful prognostic factor influencing effectiveness expressed as both mobility (RMI) and BI ($p<0.01$). Patients younger than 65 years of age had a greater probability of a good autonomy in mobility. Timely admission to a rehabilitation unit and the absence of vascular disorders in the stump correlated positively with the effectiveness of mobility.

In a study by Larsson *et al.* (1998), it was recounted that patients with diabetic foot ulcers, living independently before the amputation, which was performed during this study (index amputation), returned to living independently, more often after a minor than a major amputation (93% versus 61%; $n=189$; $p<0.001$). Seventy percent (70%) of the minor amputation patients, one year after the index, could walk 1km or more (just as before index amputation), compared with 19% of patients having a major amputation ($p<0.001$). Seventy percent (70%) of the patients after an index trans-tibial amputation who could walk before amputation were fitted with a prosthesis, and after one year 52% were using the prosthesis on a regular basis.

Finally, in a study of Gauthier-Gagnon *et al.* (1998) ($n=396$), it was concluded that adaptation to the amputation and prosthesis ($p<0.001$) and level of amputation ($p<0.01$), were significantly correlated with prosthetic wear and active use both in and outdoors. The presence of arthritic disorders in the contralateral limb were negatively related to prosthetic use ($p<0.005$), but for outdoor activities, sores, muscle cramps and claudication pain were the most limiting factors ($p<0.05$). Cardiac and respiratory problems ($p<0.005$), delays in limb fitting ($p<0.05$) and prolonged training ($p<0.001$) were significantly related to disuse (Table 2).

Phantom pain

Pain and other sensations in an amputated or absent limb, so-called phantom pain and phantom sensations, are well-known phenomena, which can influence the rehabilitation process and could also be mentioned under the predictive factors. Houghton *et al.* (1994) described that there was no significant difference in the amount of

Table 2.

Assessment method	Predictive factor for successful rehabilitation/most powerful*	Author**
Medical records Telephone interview	<ul style="list-style-type: none"> • ADL performance / + • level of amputation / + • advanced age / - 	Weiss ('90)
Reintegrate to normal living index	<ul style="list-style-type: none"> • co-morbidity / - 	Nissen ('92)
Functional independence Measure/Houghton Scale	<ul style="list-style-type: none"> • co-morbidity / - • level of amputation*** / - 	Leung ('96)
Rivermead Mobility Index/ Barthel Index	<ul style="list-style-type: none"> • advanced age / - • timely admission to rehabilitation centre / + 	Trabalessi ('98)
Amputation index	<ul style="list-style-type: none"> • walking distance / + • living conditions / + 	Larsson ('98)
Prosthetic profile of the amputee	<ul style="list-style-type: none"> • health status / + • level of amputation*** / - • co-morbidity / - • social status / + • delay / - • motivation / + 	Gauthier ('98)
Rehabilitation questionnaire (including phantom pain)	<ul style="list-style-type: none"> • phantom pain / - 	Houghton ('94)

*: + means positive correlation

- means negative correlation

** : only the first authors are mentioned

*** : proximal is worse

phantom pain experienced by vascular and traumatic amputees, but in their study there was a high prevalence of traumatic amputees (56% versus normal 8-10%). This study suggests that phantom pain is one of the important factors involved in determining a patient's rehabilitation on a prosthetic limb. In a prospective study of Nikolajsen *et al.* (1997) it was found that pre-amputation pain significantly increased the incidence of phantom pain after 3 months ($p=0.03$). An incidence of 75% was found 6 months after amputation ($n=60$). In general, all articles found suggest that phantom pain influences the rehabilitation process negatively.

Skin problems

Mueller *et al.* (1995) described that patients ($n=107$) with a transmetatarsal amputation often present with a complicated medical condition and that they are at high risk of skin breakdown or higher amputation, especially in the first 3 months after surgery. Generally in patients who are amputated for vascular reasons there is a

high prevalence of diabetes mellitus or a history of previous vascular reconstructive failure. Skin breakdown due to bad vascularisation is a danger and thus a threat to rehabilitation. Protection of the stump and the choice of a good amputation (level) is of great importance.

Discussion

About 80% of patients with a lower limb amputation are older than 60 years. These patients have, regarding their age and reasons for amputation, such as generalised vascular disorders, more or less co-morbidities. These co-morbidities, diabetes, osteoarthritis or stroke, have a negative effect on rehabilitation and will reduce the chance for a successful rehabilitation. Elderly amputees are often limited in mobility in and outdoors. This has also a negative effect on the quality of life of the elderly amputees.

Many publications have different outcomes, because of different descriptions of the populations investigated. Negative predictors for a successful rehabilitation are: the existence of

co-morbidity, advanced age and the level of amputation. Phantom pain and skin problems can also influence the rehabilitation process negatively. Positive predictors for a successful rehabilitation are: the ability to perform ADL activities before amputation; no delay for admission to a rehabilitation centre; a good walking distance before amputation; a fair to good living condition, social and health status before amputation. Finally, good motivation of the patient and rehabilitation team, and good communication, will also increase the chance for a successful rehabilitation.

Besides this, the rehabilitation process is based on individual goals with a patient tailored rehabilitation programme for each amputee. Each country has a different culture and a different financial system and therefore the goals set between the amputee and the rehabilitation team are also different. A meta-analysis was thus not possible considering rehabilitation in amputees regarding the different populations described and the individual goals set.

In general, reviewing the literature, the results of rehabilitation of the amputee seem to be poor. This is in the authors' opinion due to the generalisation of the measurement instruments used in literature which are not focussed on the individual's rehabilitation goal. Amputee rehabilitation has a need for specified measurements/questionnaires to answer these questions. At present, the "Prosthetic Profile of the Amputee" reaches this goal most closely. There is a need for further research to identify the pre- and prosthetic profile of the person with a lower limb amputation with respect to the possible rehabilitation training process.

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