

## The effect of prosthetic rehabilitation in lower limb amputees

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### Abstract

The objectives of this project were to ascertain whether, to date, the views concerning the determination of prosthetic candidacy have been optimal and whether the training methods applied have been effective and have resulted in constant use of the prosthesis after conclusion of the training programme. Secondly it was intended to set up guidelines for future budgeting as well as providing a reference framework for the process of rehabilitation.

An inquiry based on questionnaires was the first phase in a quality assurance project carried out among 29 amputees trained in 1990 and 1991.

The result of the inquiry was that rehabilitation using PTB prostheses for 19 trans-tibial amputations in 18 cases (one patient was a bilateral trans-tibial amputee) led to constant use of the prosthesis and that advanced age was no hindrance to constant use in this group. For 10 trans-femoral amputees the inquiry revealed that advanced age combined with problems of donning the prosthesis was a hindrance to constant use in two cases.

It is concluded that there is a need for testing/developing new types of femoral prostheses. The patients' evaluation of the rehabilitation process and their prostheses stresses the need for communication between the team of professionals and the patients in the

decision process concerning the provision of a prosthesis as well as the provision of complete information on the patients' future functional possibilities. Qualitative measurements must include the kind and number of medical complications and the social conditions of the amputee as well as tests of physical and mental resources.

### Introduction

In Denmark economic restrictions have been experienced within all areas of health services. As regards prostheses for amputees the funding is held by the local authorities and not by the hospitals though prosthetic fitting is part of the treatment of the amputee.

This study was made to provide information on prosthetic fitting and its outcome. The hypothesis of the study rests on the assumption that estimates of outcome regarding especially trans-femoral amputees of a relatively old age have been too optimistic and that provision of a prosthesis in these cases has not led to constant use of the prosthesis after rehabilitation. Use in this sense is defined as daily use; a minimum requirement in the study was the use of the prosthesis for transfer.

There was, furthermore, a general wish in the department to know more about the patients after discharge from hospital.

Few recent follow-up studies are available, and making comparisons is difficult, as the selection methods used regarding prosthetic fitting vary and thus so does the subsequent success rate (Pohjolainen *et al.*, 1991; Kullman, 1987).

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Developments within vascular and orthopaedic surgery are also assumed to have influenced the number of amputations as well as the features of the group of patients as regards age and pathological picture.

### Design

The study was designed as a quality assurance project. The project was divided into two main phases:

Phase 1: Interviews of patients based on questionnaires (see Appendix). A physiotherapist carried out the interview according to the questionnaire either in the home of the patient or at the hospital as preferred by the patient. The questions were grouped into three main categories. (A) Family and housing conditions. (B) Use of the prosthesis. (C) The opinion of the patient him/herself.

Training was to have been concluded at least three months before the interview was made.

Phase 2. Adjustment of objective and construction of reference programmes.

This paper describes the first phase of the project.

### Material

In the period from January 1, 1990 to December 31, 1991, patients were studied who were lower limb amputees at the trans-tibial and trans-femoral level and who had subsequently been provided with a prosthesis.

Of the 105 amputees in this period, no attempt at prosthetic provision was made in 62 cases comprising patients with a median age of 73.5 (32 to 92) years since rehabilitation was thought to be unfeasible. Some 43 patients (41%) were provided with a prosthesis of which 14 had died at the time of study. The remaining 29 patients (22 male and 7 female) were included in the study carried out over a median period of 10.5 months (3 to 22 months) after conclusion of training.

The patients with prostheses comprise 18 unilateral trans-tibial amputees, 1 bilateral trans-tibial amputee and 10 trans-femoral amputees.

The median age of the unilateral trans-tibial amputees was 64.5 (25 to 90) years and for the trans-femoral amputees the median age was 63 (17 to 94) years.

The disease or reason for amputation was

arteriosclerotic occlusive disease in 22 cases – in 15 cases with associated diabetes mellitus – in 4 cases trauma and in 3 cases malignant diseases.

All trans-tibial amputees were provided with a PTB (pattellar-tendon-bearing) prosthesis. Eight of the trans-femoral amputees had a total contact socket prosthesis with free knee motion, 1 patient was provided with a suction socket prosthesis with knee lock, and 1 with a suspension socket prosthesis with knee lock.

All amputees were referred to physiotherapeutic training immediately after operation. The objective of training after provision of a prosthesis was to regain their ability to walk as well as their functional abilities.

The method used was bandaging and pain treatment, a training programme comprising contraction prevention, strengthening, standing and balance training and walking training. Furthermore, the programme involved training in various other functions as well as evaluation of the need for supplementary aids/remedial measures normally in connection with a visit to the patient's home and carried out by occupational therapists and physiotherapists in cooperation.

The total training period for trans-tibial amputees (unilateral amputees) was a median period of 187 (86 to 314) days (6 months). For trans-femoral amputees the training period lasted for a median period of 217 (115 to 291) days (7 months).

The median time for the provision of the raw prosthesis for the group as a whole was 68.5 days (72.5 days for trans-tibial amputees and 63 days for trans-femoral amputees).

Home visits were made in 21 instances by occupational therapists and physiotherapists from the hospital.

### Results

#### *Family and housing conditions*

At the time of the study 28 patients resided in their own home (1 in an apartment with special accommodation for physically handicapped). One trans-femoral amputee had followed his wife to a nursing home.

#### *Prosthetic use*

To the main question of use/non-use of the prosthesis the study showed that 17 of the

Table 1. Definition of bad, fair and good result

Bad	Fair	Good
- does not use prosthesis	- indoor walking	- does not use wheelchair
- uses prosthesis for cosmetic purpose	- mainly indoor walking, but also slight outdoor walking	- goes for walks
- uses prosthesis for transfer	- walking on stairs	- leads an active, outgoing life

unilateral trans-tibial amputees and 1 bilateral trans-tibial amputee used their prostheses every day. One unilateral trans-tibial amputee (5.3%) had given up using the prosthesis after having had a fall. As regards the trans-femoral amputees 7 patients used their prostheses every day. The reason for not using the prostheses was advanced age (94 and 91 years) (20%) apart from experiencing problems in donning the prostheses. The prostheses in these two cases were suspension socket and suction socket prostheses respectively both with knee lock. One patient did not use his prosthesis (total contact socket prosthesis) temporarily stating that he managed equally well without the prosthesis.

#### *Putting on the prosthesis*

Fifteen unilateral trans-tibial amputees were able to put on their prostheses by themselves. Three amputees (1 bilateral trans-tibial included) had to have assistance from others (visiting nurse/domestic help).

As for the trans-femoral amputees (7 patients used their prostheses), 5 managed to put on their prostheses without any assistance, while 2 required the assistance of others (visiting nurse/domestic help).

#### *Prosthetic skill*

For determination of the outcome in relation to the objective for amputees supplied with a prosthesis various definitions were established: **bad result**, **fair result** and **good result** as outlined in Table 1.

The result of the evaluation of the functional level of the 18 unilateral trans-tibial amputees and the 10 trans-femoral amputees is stated in Table 2.

The bilateral trans-tibial amputee, who was 82 years old, used his prostheses every day for transfer.

It should be mentioned that all trans-tibial as well as trans-femoral amputees categorized as

bad or fair used wheelchairs (indoors or outdoors or both).

#### *Aids for prosthetic walking*

Of the 17 unilateral trans-tibial amputees who used their prostheses, 2 patients used a walker exclusively whereas the rest of the patients used 1 or 2 canes. Seven of the amputees were able to walk from time to time without any aids.

Of the 7 trans-femoral amputees who used their prostheses 2 patients used a walker exclusively and the other patients used 1 or 2 canes possibly supplemented by a walker. Two patients were able to walk from time to time without aids.

#### *Patients' evaluation*

The most remarkable result in section C of the questionnaire was that only 12 patients thought that their expectations as to the use of the prosthesis had been met (Table 3).

#### *Patients' evaluation of the training*

Seventeen patients thought that the training period was adequate. Nine patients felt that the period was too short (including 6 trans-tibial amputees), whereas 3 patients found that it was too long. As to the quality of the training, 24 patients thought that it was good. Five patients found that it was acceptable (Table 4).

## **Discussion**

The question of quality of life is the decisive factor when determining whether lower-limb amputees are to have a prosthesis or not. The quality of life is not precisely definable but for this group of patients it is often synonymous

Table 2. Functional level - result

Level of amputation	Result		
	Good	Fair	Bad
Trans-tibial	6	11	1
Trans-femoral	4	3	3

Table 3. Patients' evaluation

	Yes	No	No answer
Did the patient expressly want to have a prosthesis	29	0	0
Did the patient think that he/she had any influence on the decision	23	6	0
Is the patient pleased to have a prosthesis	25	3	1
Is it important to wear the prosthesis in public	17	11	1
Is the patient able to use the prosthesis to the extent he/she wishes	12	16	1

with the provision of a prosthesis and the ability to walk – a definition of life quality shared by patients as well as family and professionals.

Among professionals (surgeons, physiotherapists, prosthetists) the general opinion is that the question of whether an amputee should be provided with a prosthesis should be answered as soon as possible.

In this department the evaluations are made within 6 weeks after the amputation. The requirement as to efficiency of treatment as measured by the number of hospitalization days, ambulatory treatment days etc. affects the length of this period.

The condition of the patients is such that they are often operated on the basis of a lethal situation. The provision of a prosthesis and the successive training for a period of 6 to 7 months requires that the patient has extensive physical and mental resources. A successful life after training at the hospital depends, furthermore, on the support of the family and/or public assistance via the local authorities.

This study identifies the use/non-use of a prosthesis as well as the degree to which the prosthesis was used and the level of prosthetic

skill of 29 amputees who did in fact undergo prosthetic rehabilitation. It should, however, be noted that the patients were a fairly non-homogeneous group regarding age, reason for amputation and conclusion of training in relation to the time of the study. The project group has not sought to evaluate the professional reasons for not providing some patients with a prosthesis. Nor was it possible to evaluate the 14 patients fitted with a prosthesis who died before the time of the study.

The study has shown that rehabilitation of trans-tibial amputees with a prosthesis has in 18 cases out of 19 (unilateral as well as bilateral) led to constant daily use of the prosthesis. The group included 3 patients over 80 (80, 82 and 90 years old) who used their prostheses.

Misjudgement concerning 1 patient out of 19 is thought to be acceptable. The achieved level of prosthetic skill is also deemed to be acceptable since 11 patients had achieved a level considered as fair and 6 patients had reached a level considered to be good.

Of the 10 trans-femoral amputees 7 used their prosthesis daily. The misjudgement concerning 3 patients out of 10 comprised 2 patients of advanced age (91 and 94 years old) and 1 patient (temporary non-use) who stated that he was able to manage equally well without his prosthesis.

The achieved level of prosthetic skill of the 7 users of trans-femoral prostheses must be considered to be good since 3 patients had reached a fair level and 4 patients were at a good level.

Along with other studies (Jensen and Mandrup-Poulsen, 1983; Peter Helm *et al.*, 1986) the present study stresses the fact that the level of amputation and the subsequent prosthetic technology used are of the utmost

Table 4. Patients' evaluation of the training

## Length of the training period

Too short	9
Adequate	17
Too long	3

## Quality of the training

Poor	0
Acceptable	5
Good	24

importance for the rehabilitation result. The evaluations concerning the provision of a PTB prosthesis for trans-tibial amputees have proved that even in cases where the disease resulting in amputation has been serious and the patient of advanced age the subsequent training has led to constant use of the prosthesis. The technology of the trans-femoral prostheses applied regarding fitting and fastening make heavy demands on the users and especially those of advanced age. Evaluation of suitability for this group of trans-femoral amputees must thus be regarded as having been too optimistic in at least 2 cases (advanced age) since training did not lead to constant use of the prostheses. This tendency is in accordance with previous findings (Peter Helm *et al.*, 1986; Pohjolainen *et al.*, 1991), who found unfavourable association between increasing age and prosthetic use.

Screening methods with regard to prosthetic fitting of lower-limb amputees have been suggested by several authors. Thus, Moore *et al.*, (1989) suggested various tests with special attention to coronary artery disease. Kullmann (1987) describes the use of the Bathel Index and Russek's Classification as tools to anticipate the rehabilitation outcome. Beekham *et al.* (1987) tried to identify predictors (hip contracture, gait factors) from discharge to follow-up, but found no correlation.

In the second phase of the project a screening model has been set up concerning determination of prosthetic candidacy. The screening is multifactorial and the components categorized as follows:

1. age and medical complications, functional abilities and social dependence before the amputation.
2. qualitative estimate of mental resources such as motivation, cooperation and memory;
3. qualitative estimate of physical resources on the basis of functional tests of transfer, balance, ability to hop on one leg, ability to walk with a test prosthesis.

The question of age as a guideline in the evaluation of the prosthetic suitability of trans-femoral amputees is subject to careful consideration of the individual person and his/her autonomy.

Both trans-tibial and trans-femoral amputees need to have thorough information on the reason for the amputation, the level of

amputation as well as functional possibilities after the amputation. This information should be given to the patient prior to the operation and should be extended after the operation *pari passu* with a constant evaluation of the physical, mental and social resources of the patient. It is suggested that the dialogue between the patient and the team of professionals – the surgeon, the prosthetist and the physiotherapist – should be made on the basis of written information.

Since the patients experience problems with fitting and fastening of the prostheses in all types of trans-femoral prostheses used, it is suggested by the project group to test/develop prostheses which tend to eliminate or reduce such problems.

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### Appendix

#### Questionnaire

Name:

cpr.nr. (Central Person Register Number)

Diagnosis:

Medical complications occurring since the operation:

The following questions to be answered yes/no

A. Family and housing conditions

1A. Housing conditions.

Do you live in:

your family home?

    specially accommodated apartment for physically handicapped?

    apartment for elderly people?

nursing home?  
other?

- 2A. Family conditions.  
Do you live:  
alone?  
together with your wife/nuclear family?  
Do you have:  
frequent/good contact with your family?  
with friends?
- 3A. Employment.  
are you employed? (kind of education/job)  
Do you receive:  
old-age pension?  
disability pension?  
other?
- 4A. Remedial measures.  
domestic help? (personal care/  
housekeeping) hours per week  
visiting nurse? hours per week  
help from family/friends? hours per week  
public food service?  
centre of activities?  
training?
- B. Use of the prosthesis
- 1B. Do you use your prosthesis?  
If not for the time being - date of  
suspension?
- 2B. if no: why not?  
phantom limb pain?  
pain in the stump?  
pain in the contralateral leg?  
pain elsewhere?  
wound in the stump?  
the prosthesis does not fit? reason?  
unable to put on the prosthesis?  
manage equally well without?  
other?
- 3B. if yes: do you use the prostheses?  
for cosmetic purposes?  
now and then?  
daily? (hours per day)
- 4B. Are you able to put on the prosthesis?  
completely alone?  
alone but with some difficulty?  
need some help?  
help from ... (domestic/family)
- 5B. Walking distance (with/without prosthesis)  
transfer?  
indoor walking?  
indoor walking and some outdoor walking?  
(garden, to and from car etc.)  
go for walks? (distance metres ...)  
stairs? (number ...)
- 6B. Walking aid? (with/without prosthesis)  
none?  
1 cane?  
2 canes?  
walker?  
other?
- 7B. Do you use  
wheelchair indoor?  
wheelchair outdoor?  
electrical wheelchair?  
car? (driver/passenger)  
other?
- C. The patient's evaluation of rehabilitation  
and prosthesis.
- 1C. Was it your wish to be fitted with a  
prosthesis?
- 2C. Did you feel involved in the decision  
regarding prosthesis fitting?
- 3C. Are you pleased to have a prosthesis?
- 4C. Is it important for you to wear the  
prosthesis in public?
- 5C. Are you able to wear your prosthesis to the  
extent that you expected?
- 6C. Was the training period  
too short?  
sufficient?  
too long?
- 7C. Was the quality of the training  
bad?  
satisfactory?  
good?

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