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Functional outcome of lower-limb amputees: a prospective descriptive study in a general hospital

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Abstract

This paper describes functional outcome of a population of lower limb amputees five months after amputation compared with their pre-operative functional abilities and studies the relationship between potential determinants and functional outcome.

Twenty out of 26 patients who underwent a lower limb amputation between December 1993 and August 1994 in a general hospital in Amsterdam were included in the study. Their functional abilities before amputation were retrospectively assessed using an ICIDH (International Classification of Impairments, Disabilities and Handicaps)-based questionnaire. Functional outcome was assessed after amputation of the lower limb using ICIDH-based and SIP (Sickness Impact Profile)-questionnaires.

The mean SIP scores were high (referring to a low functional outcome). Disabilities were spread over the five disability fields of the ICIDH. The functional outcome of the diabetic versus the non-diabetic group was lower on the physical, activities of daily living (ADL), psychological and communicative categories of the ICIDH. In most patients, functional outcome decreased. The diabetic patients compared to the non-diabetics showed more diversity in functional outcome, compared with their preoperative functional abilities. Increasing age is significantly associated with a low functional outcome on the SIP scores. Diabetes is age-related for this sample. Co-morbidity and motivation are strongly age-related for this sample.

It was concluded that lower-limb amputees appear quite disabled in all disability categories of the ICIDH and as assessed by the SIP scores. In most patients, functional abilities decrease after lower limb amputation. Age seems to be a significant factor related to functional outcome.

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Introduction

Several determinants seem to play an important role in the rehabilitation process of the lower limb amputee and influence functional outcome. It is important to learn more about these prognostic determinants and their relationship to functional outcome. With this knowledge, a prognosis of functional outcome can be formulated and a better policy for rehabilitation developed.

Review of potential determinants of functional outcome

Age

Age seems to be a significant factor related to functional outcome of the lower limb amputee. Though it is not clear whether the determinant is age itself or whether increasing morbidity and diminished physical condition with age influence functional outcome (Steinberg *et al.*, 1985; Poulssen, 1988; Lavan, 1991).

Smoking, sex and body mass

In a study concerning predictive factors of functional ability after lower limb amputation, Pohjolainen and Alaranta (1991) found that smoking had an unfavourable association with walking distance, ability to walk outdoors and walking time in the male group of vascular trans-tibial (TT) amputees. Neither the sex of the amputees nor their body mass index showed any association with their walking capacity. Steinberg *et al.* (1985), Helm *et al.* (1986) and

Zijp *et al.* (1992) found no association between sex and functionality.

Length of the stump, type of amputation and bilaterality

In the study of Pohjolainen and Alaranta (1991) the length of the stump, in the group of TT amputees, had a significant favourable relationship with walking distance and in the group of trans-femoral (TF) amputees a mild positive association. However, they did not precisely describe their measurements of stump length and did not explain the relationship. Several authors (Pohjolainen *et al.*, 1990; Pohjolainen and Alaranta, 1991; Helm *et al.*, 1986; Narang *et al.*, 1984) have described a coincidence of a worse prognosis for functional performance with higher levels of amputation or bilaterality.

Co-morbidity

The presence of co-morbidity in the lower limb amputee probably will have consequences on functional performance postoperatively (Nissen and Newman, 1992; Steinberg *et al.*, 1985), however this could not always be found (Helm *et al.*, 1986; Zijp *et al.*, 1992). The presence of diabetes mellitus in one study was considered as a probable negative factor on functional outcome in the elderly amputee because of possible multi-organ damage and a higher incidence of re-amputations (Akkerman, 1983), but most studies found that the presence of diabetes mellitus made no difference in regard to functional outcome (Steinberg *et al.*, 1985; Helm *et al.*, 1986; Zijp *et al.*, 1992). In the population studied by Steinberg *et al.* (1985) more than half of the group of bilateral amputees consisted of diabetic patients. Kerstein *et al.* (1975) found that rehabilitation of bilateral lower limb amputees with diabetes mellitus was impaired severely only when visual complications or significant renal disease and hypertension were present. The presence of a heart disease is described to be a negative factor in the rehabilitation process (Kerstein *et al.*, 1975; Thornhill *et al.*, 1986), as also is chronic pulmonary disease, local stump problems (Kerstein *et al.*, 1975), stroke (Thornhill *et al.*, 1986; Pohjolainen and Alaranta, 1991) and contractures (Thornhill *et al.*, 1986). Pohjolainen and Alaranta (1991) could find no significant association between heart disease and physical function of the lower limb amputee. Three studies investigated the effect of mental problems on functional outcome. These studies all describe mental disorders as a negative factor influencing functional performance after amputation of the lower limb (Hanspal and Fisher, 1991; Kerstein *et al.*, 1975; Thornhill *et al.*, 1986).

Motivation

Motivation is influenced by physical and environmental factors. According to Zijp *et al.* (1992), a strong positive relation was found between motivation of the patient and the functional outcome. In their study, involving lower limb amputees in a nursing home, they looked retrospectively into the relationship between the results of rehabilitation in terms of functional performance and eight psychological and physical factors.

Social situation

Being employed preoperatively had favourable associations with all the ambulation functions after TF or TT amputation (Pohjolainen and Alaranta, 1991). However, employment is closely related to age and displayed similar patterns with respect to functional ambulation. Thornhill *et al.* (1986) reported on five bilateral TT amputees, who were employed at the time of second amputation and returned afterwards to work using prostheses. Independence from social provisions preoperatively (Helm *et al.*, 1986) showed favourable relationships with functional capacity and postoperative dependence after lower limb amputation. Comparison of pre- and postoperative social dependence revealed that only 6% of the patients became less dependent after operation, whereas in 36% of the patients the degree of dependence remained unchanged and in 58% it increased. No significant associations were found between functional ability and social dependence on the one hand and cohabitation on the other.

Time lag between surgery and prosthetic fitting

Time lag certainly is a dependent factor, related to wound healing, co-morbidity etc. The time lag between amputation and prosthetic supply displayed an unfavourable association with prosthetic usage (Pohjolainen and Alaranta, 1991). Knahr and Menschik (1991)

noticed in their group of 80 lower limb amputees a 100% social dependency in the group of patients without a prosthesis versus 17% social dependency in the group of patients with a prosthesis. The patients who were rehabilitated without a prosthesis had a diminished physical condition and duration of clinical rehabilitation was shorter.

Stump pain or phantom pain of the stump

Postoperative pain of the amputation stump can be disabling and can be related to co-morbidity. This pain is a dependent factor, but can be considered as an independent factor influencing functional performance. Postoperative pain in the stump or phantom pain was reported in the studies of Helm *et al.* (1986) and Pohjolainen and Alaranta (1991) and associated with decrease of functionality, particularly walking distance.

The aim of this exploratory study is firstly to describe functional outcome of a population of lower limb amputees five months after amputation compared with their functional abilities before the amputation and secondly to study the relationship between potential prognostic determinants and functional outcome.

Patients, methods and statistics

This study concerned all 26 patients who underwent a trans-tibial amputation (TTA), knee disarticulation (KD), trans-femoral amputation (TFA) or underwent a rotation osteotomy (Rot. Ost.) between December 1993 and August 1994 in the Onze Lieve Vrouwe Gasthuis, a general hospital in Amsterdam. Six patients were excluded from the study because five (1 KD, 4 TF amputees) died and one did not want to cooperate at follow-up. The population consisted of unilateral amputees: 11 TTA, 4 patients after Rot. Ost., 4KD, 1 TFA. The median age of the population was 64 years, range 17-92 years.

The outcome variables (Table 1): Patients were interviewed for the first time during admission at the hospital for the amputation. Preoperative function (three months before surgery) was assessed by using a questionnaire, based on the International Classification of Impairments, Disabilities and Handicaps (ICIDH) (Jiwa-Boerrigter *et al.*, 1990; van den Berg and Lankhorst, 1990). Assessments are made on a 4-point scale as follows:

0. The individual is able to perform activities without difficulty on his/her own, with or without the use of aids and appliances.
1. The person is able to perform activities with some difficulty on his/her own, with or without the use of aids and appliances.
2. The person is able to perform activities with much difficulty on his/her own, or with the help of others.
3. The person cannot perform activities even with aid.

Van den Berg and Lankhorst (1990) have shown that reliability of this instrument is

Table 1. List of outcome variables, consisting of 28 items in five disability fields (Jiwa-Boerrigter *et al.*, 1990)

Physical	14. preparing meal
1. transfer from lying, sitting	15. household
2. transfer from sitting, standing	16. employment
3. walking (inside)	17. recreation
4. traversing (outside)	18. family role
5. climbing stairs	19. social integration
6. reaching, retrieval, lifting	*Psychological*
7. manual activities	20. orientation
8. endurance	21. memory, attention
ADL	22. behaviour, mood
9. eating, drinking	23. learning abilities
10. using the lavatory	*Communicative*
11. bathing	24. understanding speech
12. clothing	25. talking
Social	26. hearing
13. transportation	27. seeing
	28. writing

Table 2. Potential determinants

age	<65 or ≥65 years
sex	man or woman
smoking	yes or no
type of amputation	TTA/Rot. Ost. or KD/TFA
co-morbidity:	
diabetes mellitus	yes or no
number of diagnoses	<2 or >2 diagnoses
duration preoperative admission	<39 or >39 days
motivation	good or impaired
social partner	yes or no
time lag amputation-prosthetic supply	<15 or ≥15 weeks
stump pain	yes or no

TTA: Trans-tibial amputation
Rot. Ost.: Rotation osteotomy
KD: Knee disarticulation
TFA: Trans-femoral amputation

satisfactory.

Function outcome five months after the amputation was assessed by the same ICIDH-based questionnaire as well as a Sickness Impact Profile (SIP)-questionnaire (de Melker *et al.*, 1990; Jacobs *et al.*, 1990). The SIP questionnaire has a standardised list of 136 statements aimed at measuring changes of conduct in everyday activities due to sickness, and may be used as a measure of outcome in clinical studies.

The potential determinants of outcome are listed in Table 2: They were expressed as dichotomies. Data were obtained by analysis of the medical records.

To study the relationship between the determinants and functional outcome two and three factor Analysis of Variance was applied. The chosen level of significance was $p<0.05$.

Results

The mean SIP total score of the population was 20.7%, the mean SIP physical score was 26.9%. Disabilities were spread over the five disability fields of the ICIDH. All patients showed problems in traversing (outside) at the time of follow-up. The functional outcome of the diabetic versus the non-diabetic group was lower on the physical, ADL, psychological and communicative categories of the ICIDH (Fig. 1). The functional outcome, as assessed by the ICIDH scores decreased in most patients: 13 patients functionally regressed, especially on the physical, ADL and social fields. The ambulatory activities were particularly compromised. Seven patients progressed functionally in all disability fields (Fig. 2). Four patients had a job in the year previous to amputation but none of these patients had returned to work five months after surgery. The diabetic patients compared to the non-diabetics demonstrated more diversity in functional abilities, compared with their functional abilities before the amputation, with relatively

Table 3. Relation of potential determinants and functional outcome

	outcome	number of patients in subgroup	mean SIP total score (%)	mean SIP physical score (%)
age	≥65 years	9	26.8	35.7
	<65 years	11	15.7	19.7
sex	man	12	20.4	25.3
	woman	8	21.2	29.4
smoking				
(with arteriosclerosis	yes	5	22.3	27.0
or diabetes)	no	8	22.6	31.0
type of amputation	TTA/Rot. Ost.	15	21.5	28.8
	KD/TFA	5	18.2	21.2
diabetes mellitus	yes	10	22.7	30.9
	no	10	18.7	22.9
number of diagnoses	>2	7	24.4	31.5
	<2	8	18.0	22.9
duration preoperative	>39 days	9	22.6	29.4
admission	<39 days	9	20.4	25.9
motivation	impaired	6	28.9	38.4
	good	14	17.2	22.0
social partner	yes	11	21.7	28.8
	no	9	19.6	24.6
time lag amputation-	≥15 weeks	8	22.2	28.2
prosthetic supply	<15 weeks	7	17.7	23.5
stump pain	yes	8	20.4	23.7
	no	12	20.9	29.1

SIP: Sickness impact profile
TTA: Trans-tibial amputation
Rot. Ost.: Rotation osteotomy
KD: Knee disarticulation

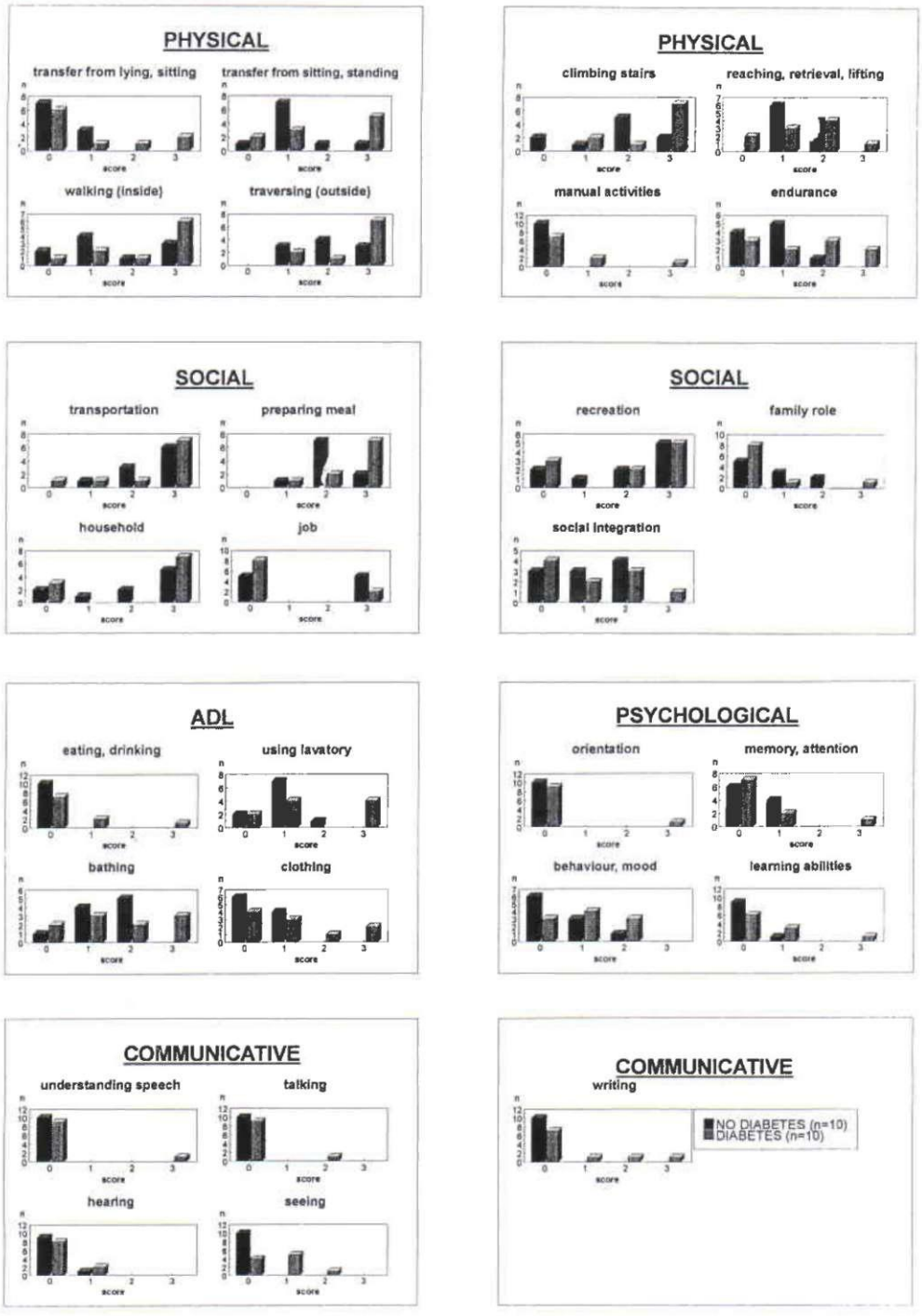


Fig 1. Functional outcome of 20 patients in five disability fields as assessed by the ICIDH scores fives months after the amputation.

Disabilities are spread over the five disability fields of the ICIDH. The diabetic patients are compared to the non-diabetics. The functional outcome of the diabetic group is lower on the physical, ADL, psychological and communicative fields.

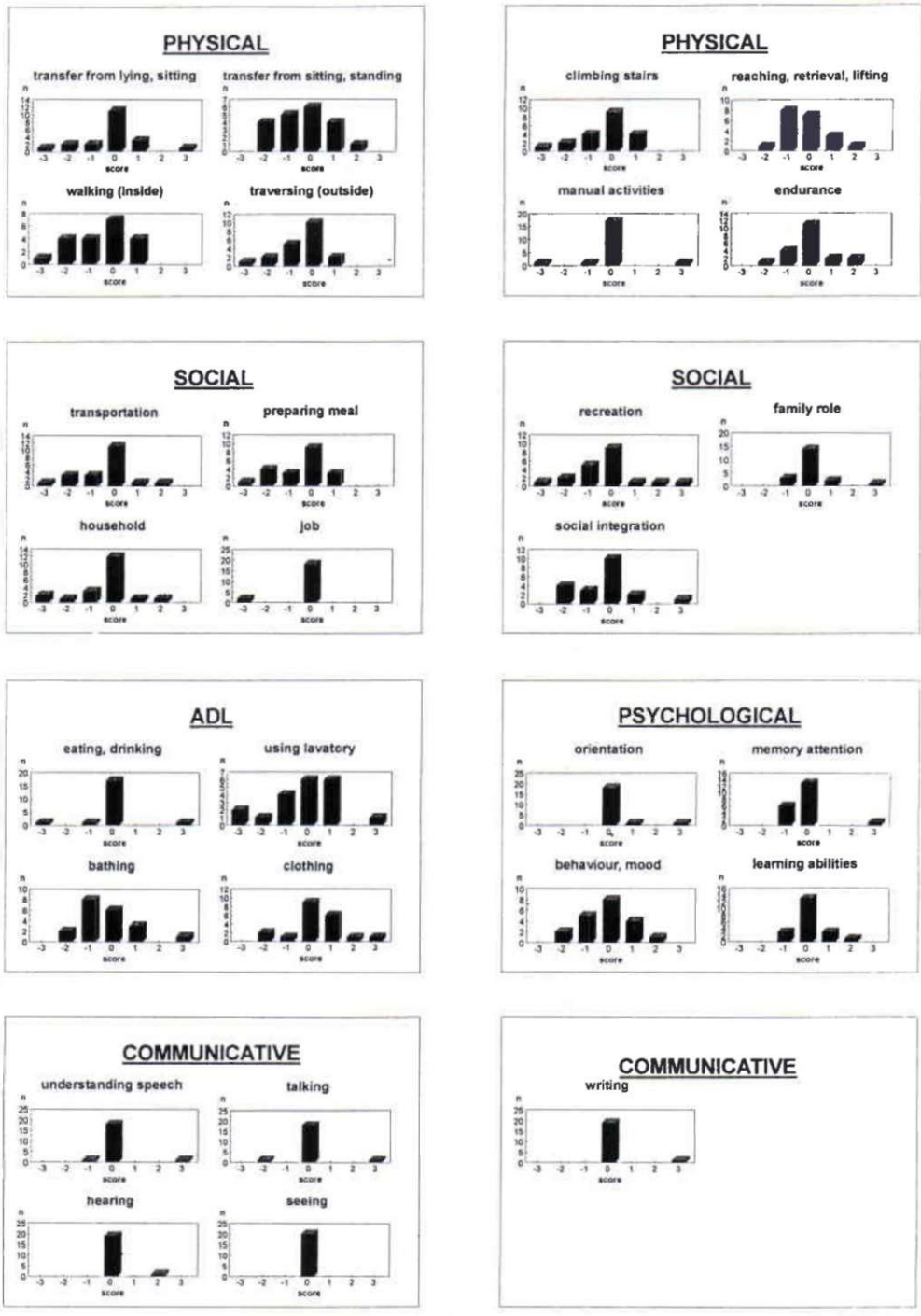


Fig 2. Functional outcome of 20 patients in five disability fields of the ICIDH five months after the amputation compared to preoperative functioning. Postoperative ICIDH acores are subtracted from the preoperative ICIDH scores. Especially on the physical, social and ADL fields a decrease in functional outcome is noted, particularly compromising the ambulatory activities. An increase in functional outcome is seen in all disability fields.

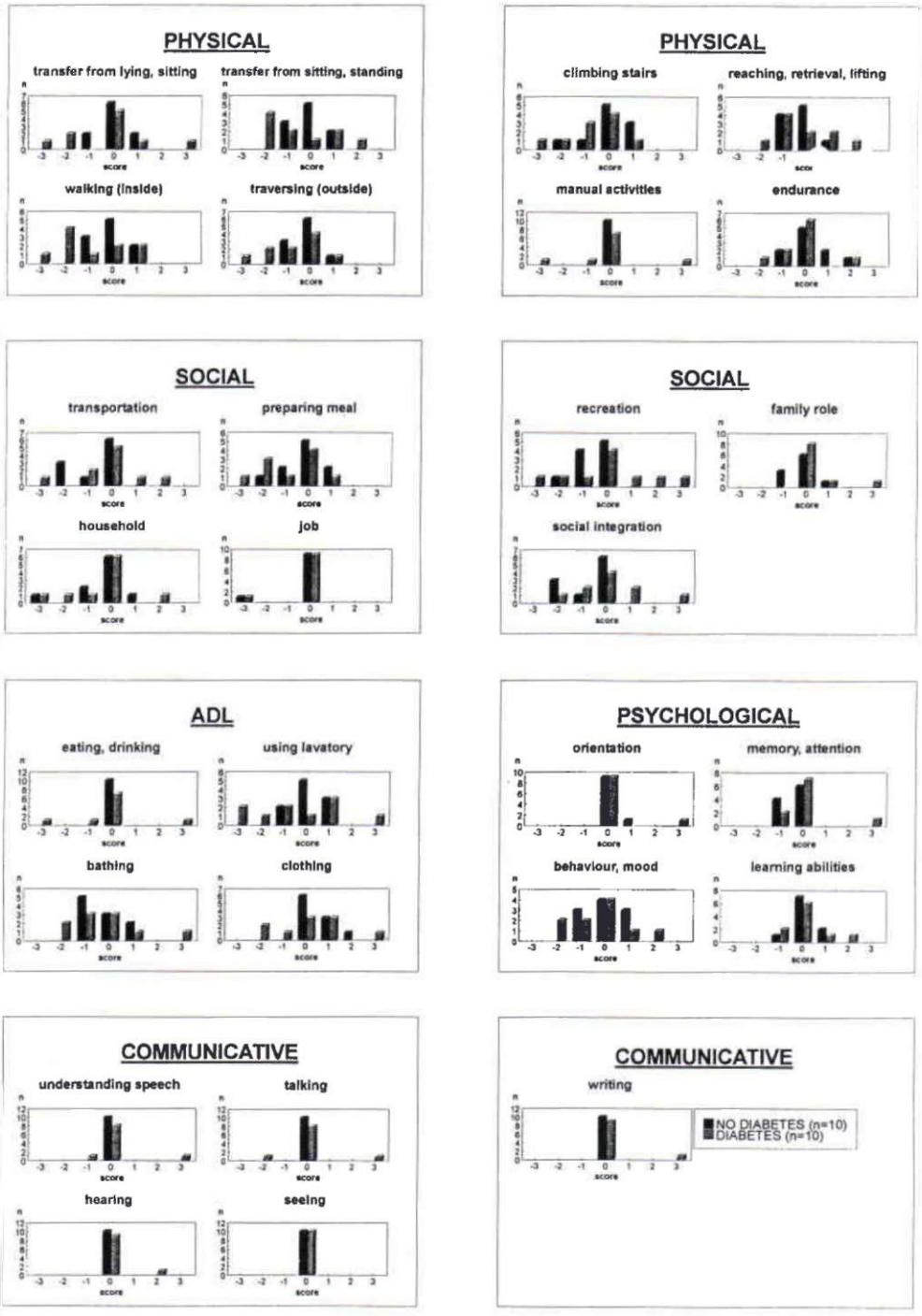
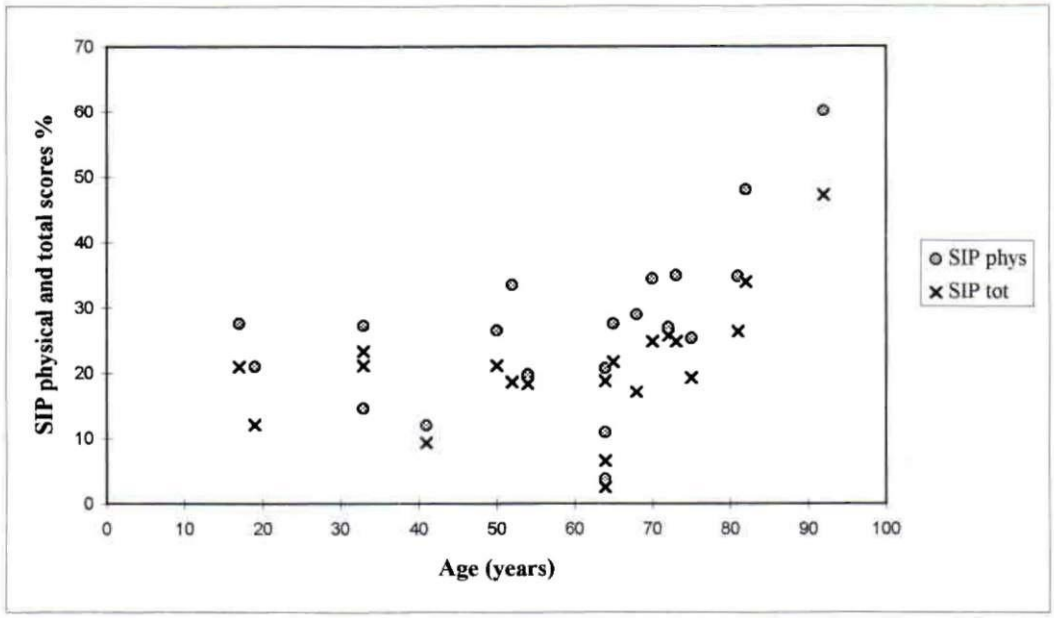


Fig. 3 . Functional outcome of 20 patients in five disability fields of the ICIDH five months after the amputation compared to preoperative functioning. Postoperative ICIDH scores are subtracted from the preoperative ICIDH scores. The diabetic patients are compared to the non-diabetics. The diabetics show more diversity in functional outcome with relatively more decline in physical and ADL fields.



SIP: Sickness Impact Profile

Fig. 4. The relation between age (years) and functional outcome as assessed by the SIP physical and total scores (%). The relation shows a zero graduated slope till the age of 65 years and an increasing slope afterwards.

more decline in the physical and ADL fields of the ICIDH (Fig. 3). No significant relationship could be found between diabetes and functional outcome on the SIP physical score and total score (Table 3). The presence of diabetes is age related for this sample. Increasing age is significantly associated with low functional outcome on the SIP physical and total scores ($p<0.05$). The relationship is shown in Figure 4. There was no correlation found between sex, smoking, type of amputation, social situation, time lag between surgery and prosthetic supply, stump pain, duration of hospital admission (during the year previous to amputation) and functional performance measured by the SIP scores. Co-morbidity and postoperative motivation are strongly age dependent for this sample. Diagnoses which were included in co-morbidity were: cardiovascular and chronic pulmonary disease, visual and hearing problems, mental disorders, problems of the musculo-skeletal system and ulcers of the lower limb. In the five postoperative months three patients underwent an ipsilateral higher level reamputation, one patient underwent an ipsilateral higher level reamputation and a contralateral lower limb amputation, one patient underwent a contralateral lower limb amputation, two patients underwent partial foot amputations. Five out of seven reamputated patients had diabetes mellitus.

Discussion

The finding of reduced functional performance of the patients five months after amputation confirms the conclusions reported in the literature, as do most of the other data. The findings of a lower functional outcome of the diabetics and more diversity in functional outcome in the different fields of the ICIDH of the diabetic versus the non-diabetic amputees could possibly be explained by the multi-organ effects of diabetes mellitus or by an age effect. It is necessary to study a larger sample of patients to be able to find a significant difference due to the presence of diabetes mellitus in regard to functional outcome. In this sample most of the reamputations took place in the patients with diabetes mellitus. So far, no other investigators have found a correlation between diabetes mellitus and functional outcome. The relation between age and functional outcome for this sample, shown in Figure 4, shows a zero graduated slope till the

age of 65 years and an increasing slope afterwards. A larger sample of patients is necessary to map out this relationship. Though it is still not clear whether age itself is a significant factor or whether increasing morbidity, diminished physical condition and maybe diminished motivation with age influence functional outcome. Nothing can be said about the correlation between amputation level and functional abilities in this study because of the unhomogeneity of the population.

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