

Functional capabilities of lower limb amputees

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Abstract

Five hundred lower limb amputees were evaluated by personal interview at the Artificial Limb Centre, Pune, India. Information thus obtained on activities of daily living and functional capabilities with their prostheses was analysed. The analysis showed that 55% of the amputees were totally independent, 40% had to use a crutch or cane and only 5% were solely dependent on a wheelchair for ambulation. Further, it was also confirmed that as age increased, functional independence decreased, and that below-knee amputees were more independent than above-knee and bilateral amputees. When compared with reports of other workers from the developed countries, the results were equally good, and in some functions, were even better.

Introduction

The aims of the survey were to obtain information directly from the patients on activities generally considered essential for daily living, vocational activities, living arrangements and changes therein. An attempt was made to ascertain the relationship of age and amputation level to the eventual outcome. Information regarding the above capabilities was recorded as supplied by the amputees themselves.

Materials and methods

A questionnaire was prepared and 500 lower limb amputees who had come to the centre in 1980/81 for repair/replacement of their prostheses were interviewed individually and their answers to the questionnaire recorded.

In the interest of simplicity, the level of amputation was divided into three categories—

- 1 Below-knee including partial foot, Syme and below-knee amputations.
- 2 Above-knee including knee disarticulation, above-knee and hip disarticulation amputations.
- 3 Bilateral including combinations of the above.

Primary evaluation consisted of relating the level of functional achievement to the site of amputation. Secondary factors considered were aetiology, age and sex. Relevant data were analysed.

Patient sample

Of the 500 patients interviewed, 298 (60%) were soldiers and 202 (40%) civilians. There were 474 (95%) males and 26 (5%) females. The ages of the patients at the time of amputation ranged from 2 to 65 years (Fig. 1.), and the oldest was now 92 years of age. The majority,

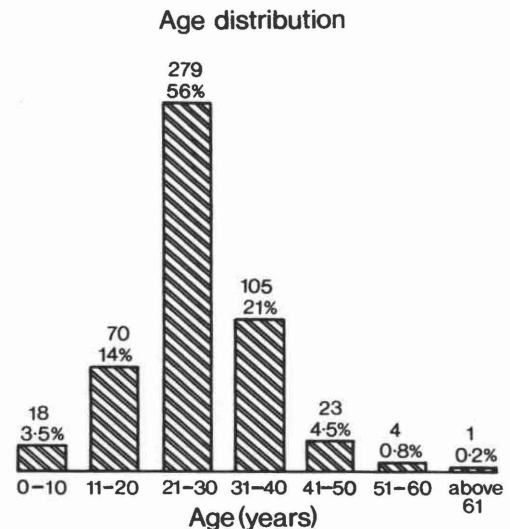


Fig. 1. Age at time of amputation.

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279 (56%), were between 21 and 30 years of age. The marital status of the amputees as found in this series is reflected in Table I. The majority of the patients (60%) married after becoming amputees.

Table 1. Marital status

	At time of amputation		After amputation	
	Married	Unmarried of marriageable age	Married	Unmarried
Male	296	160	104	56 (35%)
Female	9	17	2	15 (88%)
Total	305	177	106	71
%age	63	37	60	40

Duration of disability

The length of time since the amputations varied from 1 to 30 years as shown in Figure 2. There were 61 patients (12%) of over 30 years duration, of whom 60 were World War II veterans and one was a First World War casualty.

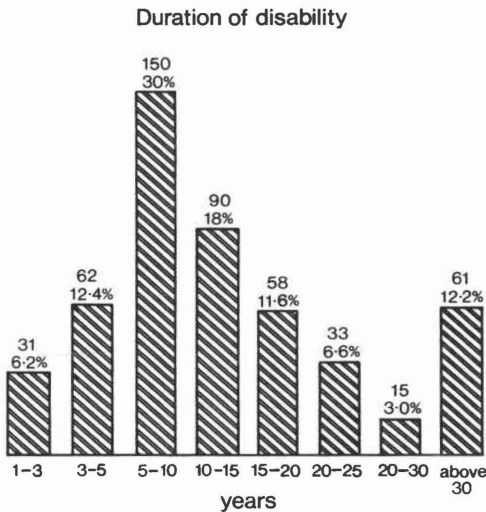


Fig. 2. Time since amputation.

Cause of disability

The majority of cases, 408 (82%), were due to trauma, 86 (17%) due to disease and 6 (1%) congenital. The aetiology for traumatic amputation is depicted in Figure 3. Among amputees who lost their limbs due to disease, 48 cases (56%) were due to Thromboangiitis

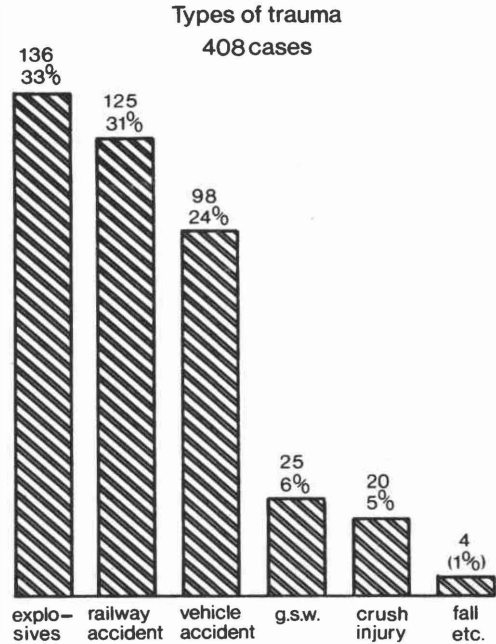


Fig. 3. Types of trauma.

obliterans, 18 cases (21%) due to gangrene, 4 (5%) due to diabetes, 6 (7%) due to sarcoma and 10 (12%) due to others.

Type of amputation

There were 308 (61.5%) below-knee, 124 (25%) above-knee and 68 (13.5%) bilateral amputees.

Results

Activities of daily living

There is an extreme paucity of information in the literature relating to activities of daily living (ADL) among amputees.

Dressing

(Including donning and doffing prostheses). All our patients could dress and don their prostheses without any external help, but some took more time than others.

Bathing

Of the total group, 80% could sit on the floor and bathe in the normal manner, 4% took a standing shower and 16% sat on a stool; both latter groups used wall, grab-bars or hand-rails to assist them. Of the bilateral amputees, 25 (37%) sat on the floor and 43 (63%) sat on a stool.

Getting in and out of chairs

Support was not required by 241 (48%) of patients but 238 needed arms on low chairs, while 21 (4%) required arms on all types of chairs. Of the below-knee amputees, 67% did not require any support, while in above-knee about 67% amputees did need support.

Use of aids for ambulation

Table 2 shows that 267 cases (53%) used no assistive devices, 204 cases (41%) used one cane and the remaining 29 cases (6%) used 2 canes or crutches and wheelchairs. Out of 60 bilateral amputees, 12 used wheelchairs exclusively.

Many more patients between 31 and 60 years used one or more assistive devices compared to those younger than 30 years. When both age and level of amputation are considered, 54% of below-knee under 30 years and 10% of below-knee above 30 years did not need assistive devices. In the above-knee group, 31% of those 30 years of age and under, and 7% of those above 30 years did not need assistive devices. In bilateral amputees, 25% of those under 30 years and 4% of those above 30 years did not need assistive devices.

Table 2. Amputation level and use of assistive devices

	Below-knee	Above-knee	Bi-lateral	Total	%age
None	199	48	20	267	53.4
One cane	107	72	25	204	40.8
Two canes	1	1	11	13	2.6
One crutch	1	2	—	3	0.6
Two crutches	—	1	—	1	0.2
Wheelchair	—	—	12	12	2.4
Total	308	124	68	500	

Daily distance walked

Twelve per cent of the total patient population felt that they walked as much as non-amputees. Most of the patients (84%) walked outdoors daily for approximately 1-2 km, 1.5% walked only in the house, and 2.5% (among bilateral cases) did no walking at all.

Use of stairs

Patients were asked their ability to ascend (Fig. 4.) and descend (Fig. 5.) stairs. Only 27% of the group did not need help, while 3% (all bilateral) could not manage stairs at all. Those needing hand rails or other assistance totalled 70%. Of the total group, 16% descended stairs

step over step, while 81% preferred one step at a time. Thirteen bilateral cases could not use stairs either way.

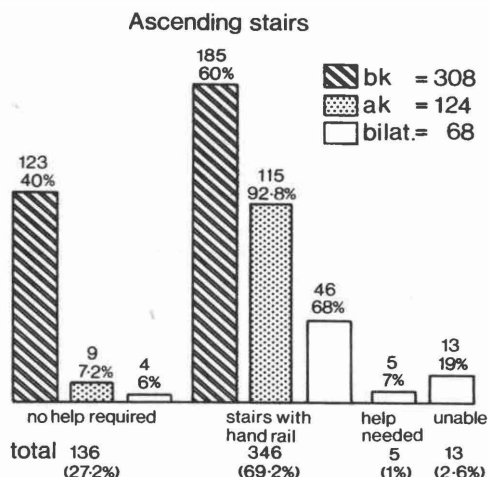


Fig. 4. Stair climbing ability.

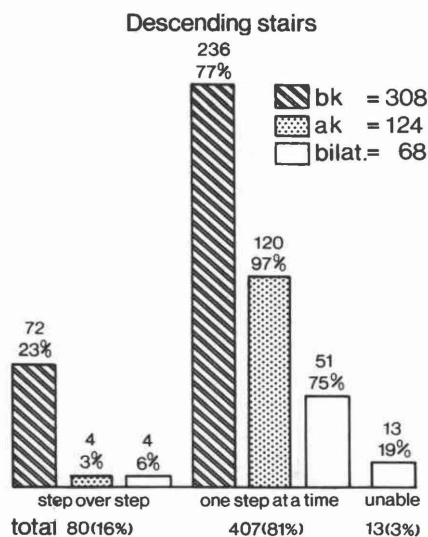


Fig. 5. Stair descending ability.

Use of ramps

Most patients (92.8%) had no trouble using ramps (Fig. 6.), while 4.6% needed help and 2.6% could not manage ramps at all with their prosthesis but could use them with a wheelchair.

Getting up from the floor

Getting up from the floor, a fairly simple task,

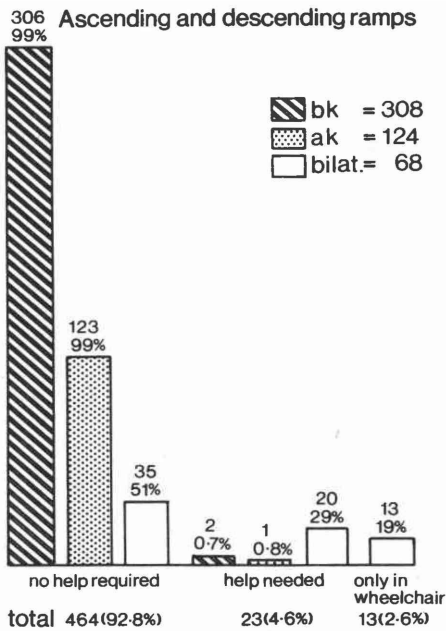


Fig. 6. Use of ramps.

can be difficult for the individual who lacks proprioception and push off. Thus, 8% of below-knee, 14% of above-knee, and 41% of bilateral amputees needed help, while 30 patients in all, including 15 (22%) bilateral amputees, could not get up from the floor.

Transportation

The ability to drive and use public transport is an important part of today's life style. The majority of patients, 417 (83%) had no previous driving experience. Only 6% could drive a vehicle.

Two hundred and forty patients (48%) could ride a bicycle while 250 (50%) stopped cycling after amputation and 10 (2%) did not know how to cycle even prior to amputation (Fig. 7).

Concerning the use of public transport, 485 (97%) cases could use taxis, buses and trains; and 15 (3%) could use some forms of public transportation but not all.

Employment

Of all the patients 12% stayed in the same job while 47% had to change occupation; only 3.5% were unable to work and another 4% were able to work but were unemployed.

Living arrangements

The ability to return to and maintain a normal

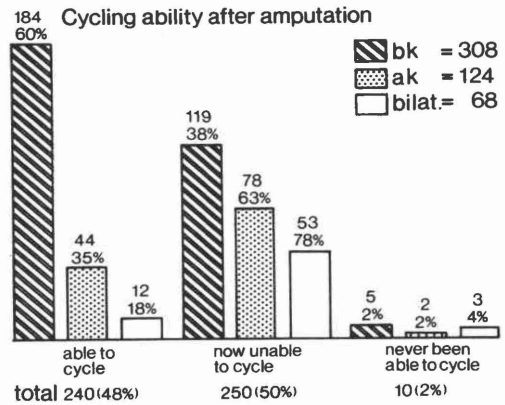


Fig. 7. Cycling ability after amputation.

home life is an important aspect of total rehabilitation. The patients were asked three questions (1) Where do you now live? (2) Did you have to change your living arrangements? (3) Did you make modifications in your home?

Ten (2%) lived alone, 177 (35%) lived with their own families and 313 (63%) lived with several families.

Most patients 479 (96%), had not changed their living arrangements. The 21 (4%) who had changed because of amputation, included 9 (3%) below-knee, 2 (2%) above-knee and 10 (15%) bilateral amputees. Two patients had ramps installed in place of steps. Some converted the Indian type latrine to Western commode. Others put a small platform or chair in the bathroom. Some had a railing attached to the adjoining wall.

Sexual relationships

Seventy four per cent of the amputees stated that they had not experienced any change in their sexual relationships since amputation; 18% were unmarried. The 8% who said that they were affected, included 16 below-knee, 15 above-knee, and 10 bilateral amputees.

Other effects of amputation

Of the 500 amputees, 438 (87%) could not walk as before, 299 (60%) could not walk long distances, 319 (64%) could not climb, 286 (57%) could not do heavy lifting, 427 (85%) could not play outdoor games and 394 (79%) could not kneel/squat.

Classification of functional level achieved

To summarize the information given in this section, the patients were classified into five

simple categories (Table 3).

- Class I — Totally independent.
 Class II — Independent with one cane or crutches.
 Class III — Independent in home ambulating with prosthesis, but need wheelchair for outdoor activities.
 Class IV — Independently ambulant with crutches, but not wearing a prosthesis.
 Class V — Non-ambulatory except in wheelchair.

Table 3. Functional outcome of amputation

	Below-knee	Above-knee	Bi-lateral	Total
Class I	216 (70%)	45 (36%)	20 (30%)	281 (55%)
Class II	90 (29%)	79 (64%)	29 (42%)	198 (40%)
Class III	2 (1%)	—	7 (10%)	9 (2%)
Class IV	—	—	—	—
Class V	—	—	12 (18%)	12 (3%)
Total	308	124	68	500

Functional outcome was compared to level of amputation and age at time of amputation. Data were analysed revealing the following.

Age had a definite effect on the functional outcome of the patient; as age increased, functional independence decreased.

There was also a significant relationship between the level of amputation and functional outcome. The below-knee amputee was more independent than the above-knee and the bilateral amputee.

There was a significant age and level of amputation interaction indicating that relative to the below-knee amputee, the above-knee amputee's functional independence decreased more rapidly with age. The functional decline of the bilateral amputee in comparison to the below-knee amputee was even more rapid.

Discussion

This study was carried out to document some of the characteristics of the amputee and to compare the results with those of other authors who have done similar studies.

The patient sample was compared with those

of other investigators. A sex distribution of 95% males and 5% females in this series differs from that reported by Glattly (1964) and Kegel et al, (1978) which was 77% males and 23% females. An earlier survey done in this centre of 14,400 civilian new patients (Narang and Jape, 1982) showed 88% males and 12% females. The lower incidence of female patients in this study is probably due to the socio-economic structure of a male dominant society. Women also usually stay at home and are thus less exposed to the hazards of trauma.

This study also shows a greater trend towards below-knee amputations. Of this sample 62% had a below-knee amputation as compared to 56% in the Kay and Newman study, 39% in the Glattly study and 65% in the Kegel et al study.

Glattly did not mention bilateral amputee status, but Kegel et al showed it as 15% and Kerstein et al, (1974) as 23%. In this study it was 14% of the total number.

The mean age of 25 years at the time of surgery for this sample was much lower than that of other investigators (Kegel et al — 45 years, Kerstein et al — 57 years, Stern (1976) — 65 years, Silverstein and Kadish (1973) — 66 years, and Bugel and Carlson (1961) — 65 years). The explanation for the difference is that the main cause of amputation in this series is trauma (82%) in a younger age group and not diseases of old age such as arteriosclerosis (Table 4).

Table 4. Reason for amputation.

	Disease	Trauma	Tumour	Congenital
Present study 1979-1980 lower extremity	16%	82%	1%	1%
Kegel et al 1964-1976 lower extremity	49%	35%	8%	7%
Glattly 1961-1963 upper and lower extremity	58%	33%	5%	4%
Kay and Newman 1973-1974 upper and lower extremity	70%	22%	5%	3%
Kerstein et al 1961-1971 lower extremity	85%	7%	3%	5%
Davies et al 1965-1967 upper and lower extremity	37%	50%	4%	8%

Amputations occur mostly among younger people exposed to work hazards and also due to the ignorance and lack of observations of safety measures in India.

None of the patients had problems in donning their prostheses, being young individuals. Bathing presented problems to only 20% amputees (Table 5), while Kegel reported 55%. Indians usually bathe in a squatting position on the floor. Some of the above-knee and a large number of bilateral amputees required a stool, or showered and used grab bars.

Table 5. Comparison with other studies.

	Present study	Kegel et al	Kerstein et al
Dressing problem	None	13%	
Bathing difficulty	20%	55%	
Help required getting in and out of chairs	52%	60%	
Ambulation device required	47%	44%	
Bilateral amputee— independent ambulation with or without cane	68%	25%	40%
Bilateral amputee— wheelchair user	18%	40%	54%
Unable to use public transport	3%	2%	
Employment			
Same occupation	13%	22%	
Changed occupation	50%	4%	
Unable to work	35%	8%	
Change of home	1.5%	13%	
Change in sex life			
Below-knee	5%	8%	Whole
Above-knee	12%	22%	group
Bilateral	15%	35%	15%

Of the bilateral amputees evaluated, 68% were independently ambulant with or without cane and 18% used wheelchairs. These figures may be compared with those reported by Kegel et al— 25% and 40%, and Kerstein et al— 40% and 54% respectively. The higher incidence of functional capability in bilateral amputees in this study is because the majority of the patients were younger.

Cycling is the commonest and cheapest mode of transport in India and evaluation showed that of the 98% who could ride a bicycle before amputation, 50% gave up riding, but 60% below-knee, 37% above-knee and 19% bilateral amputees could still ride.

Public transport could be used without much difficulty by 97% of patients. Only 3%, who were all bilateral amputees, experienced difficulty in getting into the bus because of steps, short halts, etc.

Only a small percentage (12%) returned to the same occupation, 47% had to change their professions after amputation. Since 60% of the amputees covered in this study are soldiers, it follows from the nature of their previous work that a majority of them have to change their occupation. Among the civilians, people engaged in physical labour have to seek alternate jobs. This explains the difference in this regard between this study and that of Kegel et al where only 4% changed their jobs and that of Kerstein et al where only 15% changed their jobs.

Those previously engaged in physical labour are unable to find work after amputation because they have a low educational level. They lose their jobs due to physical inability and find difficulty in getting other jobs because of intellectual inability.

The ability of the amputee to return to and maintain a normal home life is extremely important. In this study, most of the amputees did not have to change their homes. This is more due to circumstances than choice. Most Indians live in overcrowded homes. Finding suitable accommodation after amputation is well nigh impossible. Most of them who are used to living in crowded, inconvenient homes with inadequate sanitary facilities continue to do so after amputation because of financial difficulties in finding new homes and scarcity of alternative housing.

It was observed that 85% of amputees could no longer take part in outdoor games.

Patients whose sexual relationships were adversely affected because of amputation were 5% below-knee, 12% above-knee and 15% bilateral, whereas in the Kegel et al study it was 8% below-knee, 22% above-knee and 35% bilateral, and in Kerstein et al it was 15% all together. The reasons are as follows. First of all, the amputees in this series were much younger. The other reason is that 61% of these amputees who were of a marriageable age, were already married. Of those who were not married before amputation, 60% married later.

Contrary to the assumption that loss of limbs may cause a psychological barrier to normal sexual behaviour, it was found that none of our amputees experienced such a barrier. On the contrary, most of them confessed to a heightened sexuality. Another thing is that women generally being passive and submissive in India, rejection by wives is rare.

The patients whose sex life is adversely affected are those who could not get married. They have few outlets since sexual permissiveness is still more or less a taboo.

An examination was made of the impression that below-knee amputees do better than above-knee amputees who in turn do better than bilateral amputees. Results confirm that below-knee amputees definitely do need less help than above-knee and above-knee less than bilateral amputees. In total functional outcome 70%

below-knee, 36% above-knee and 30% bilateral were found in Class I.

The patients identified the following needs in their suggestions for improvement. Only 153 offered suggestions.

- (a) A few wanted a more cosmetic looking foot.
- (b) A few wished for a more durable foot.
- (c) A few complained of the heavy weight of prosthesis.
- (d) Some wanted a manual on the maintenance of prostheses.
- (e) Some suggested ventilation holes and others water proofing of the artificial limb.
- (f) The majority complained of frequent breaking of locking joints and wished these to be more durable.

FUNCTIONAL CAPABILITIES SURVEY AMPUTEES

Interview Schedule

Name: _____ Disability No. _____
 Age: _____ Sex: _____ M/S State: _____
 Income: _____ Source of payment: _____
 Education: _____
 Do you receive pension benefits? Yes/No
 Any other benefit/compensation/None.
 How long ago was your arm/leg amputated?
 Which arm/leg? Rt/Lt/both
 If arm, were you right-handed or left-handed before amputation?
 Level of amputation: _____

Phantom feeling

- (a) No phantom feeling
- (b) Can feel just part of missing limb
- (c) Can feel entire missing limb
- (d) Phantom is same length as opposite limb
- (e) If leg, phantom is used when walking
- (f) If arm, there is movement in fingers of phantom
- (g) Missing part is painful and requires medicine
- (h) Missing part is painful but requires no medicine
- (j) Other

Condition of stump

- (a) Scar along front/bottom/back of stump
- (b) Any other surgical scar on amputated limb?
Yes/No

If Yes, reason:

- (c) Does the amputation scar adhere to bone? Yes/No
- (d) Does fluid ever drain from anywhere on the limb?
Yes/No
- (e) Do you have any areas that are tender to touch?
Yes/No
- (f) Is your stump painless/uncomfortable/painful?
- (g) Any other condition:

Condition of unamputated limb

- (a) Normal
- (b) Does not allow me to be very active
- (c) Some cramping, but no problems
- (d) Open sores present
- (e) Painful all the time
- (f) Other:

Social adjustment

Do you live alone/with your nuclear family/in a joint family?

How have your family/friends responded to you as an amputee?

Do you feel that people are more reluctant to accept you socially since your amputation? Yes/No/Do not know

Do you feel handicapped or deprived from leading a normal life? Yes/No

If Yes, how:

Has your amputation affected your sexual activities, either physically or emotionally? Yes/No

Do you feel there is a change in your personality as a result of amputation? Yes/No
Do you find the appearance of your prosthesis a social embarrassment? Yes/No. Comments:

Prosthetic history

How long have you had a prosthesis?
Do you still wear your prosthesis? Yes/No
How many prosthesis have you had since your amputation?
Have you ever had a prosthesis from somewhere else? Yes/No
Have you made any modifications to your own prosthesis? Yes/No
If Yes, how?
How many hours per day do you wear your prosthesis?
(a) Do not wear at all
(b) 0-2 hours
(c) 2-4 hours
(d) 4-6 hours
(e) All day
(f) If arm, specify hand/hook

Putting on and removing prosthesis

(a) Can do completely alone
(b) Need some help
(c) Other
How long does your prosthesis last before you need a new one?
Is your prosthesis comfortable when you wear it? Yes/No
Comment:
Do you feel that the prosthesis is as much a part of you, as your other limb? Yes/No
How?
How long did you go for training after you got your first prosthesis?
(a) No training
(b) Less than two weeks
(c) 2-4 weeks
(d) 1-2 months
(e) 2-4 months
(a) Longer than 4 months
Length of time between surgery and completion of prosthetic training:
(a) No training
(b) One month
(c) Two months
(d) Four months
(e) More

FOR LEG AMPUTEES ONLY

Description of prosthesis

How do you keep your prosthesis on?
(a) Do not wear
(b) Cuff suspension
(c) Waist belt
(d) Leather corset
(e) Pelvic band
(f) Cuff suspension with waist belt
(g) Shoulder harness
(h) Muscle contraction (for BK)

(j) Total suction
(k) Any other
How many stump socks do you wear?
(a) Do not wear prosthesis
(b) One 3 ply
(c) Two 3 ply
(d) More
(e) None

Use of prosthesis

How do you get in and out of chairs?
(a) Do not need chair arms
(b) Need arms on low, sunken chairs
(c) Need to use arms on all chairs
(d) Other
Do you have a wheelchair? Yes/No
If yes, for which activities?

Mobility

(a) Use no crutches, canes etc
(b) Use one cane
(c) Use two canes
(d) Use one crutch
(e) Use two crutches
(f) Use walker
(g) Do not walk at all
(h) Use wheelchair
(j) Other

Outdoor Indoor

How do you manage kerbs?
(a) Without help
(b) Need help
(c) Cannot manage at all
(d) Other

Going down stairs

(a) Step over step
(b) One step at a time
(c) Other

Ramps

(a) Do not need help
(b) Need help
(c) Can only go up ramp
(d) Cannot go up or down ramp
(e) Other

Getting up from the floor

(a) Do not need help
(b) Need help
(c) Other

Dressing

(a) Can dress and undress completely alone
(b) Need help in getting dressed and undressed
(c) Other

Bathing

(a) Sit on floor
(b) Take standing shower
(c) Other

Amount of walking

(a) As much as anyone
(b) Walk in house + 6 Km.
(c) Walk in house + 5 Km.

- (d) Walk in house + 4 Km.
- (e) Walk in house + 3 Km.
- (f) Walk in house + 2 Km.
- (g) Walk in house + 1 Km.
- (h) Walk in house + ½ Km.
- (j) Walk only in house
- (k) Do not walk

Driving/motor cycle riding/cycling

Public transportation

- (a) Can use taxi
- (b) Can use bus
- (c) Can use airplane
- (d) Can use train
- (e) Can use all above
- (f) Other

Extra activities

- (a) Swimming
- (b) Running
- (c) Track games
- (d) Basketball
- (e) Football
- (f) Other

Work situation

- (a) Retired and stay at home
- (b) Part time work
- (c) Full time work
- (d) Able to work, but unemployed
- (e) Unable to work for reasons other than amputation
- (f) Unable to work because of amputation
- (g) Doing different type of work because of amputation
- (h) Child, do not work yet
- (j) Other

Type of work

- (a) Do not work
- (b) Sedentary (sit most of the day)
- (c) Stand most of the day
- (d) Heavy lifting involved
- (e) Great deal of walking involved
- (f) Other

Any other medical complication since amputation, how long?

- (a) Blindness
- (b) Stroke
- (c) Heart attack
- (d) Diabetes
- (e) Other

What do you do now that you are an amputee that you could not do before?

What could you do before that you cannot do now because of amputation?

Have you had to change your living place because of amputation? Yes/No

Have you had any modification done to your home because of amputation? Yes/No

If yes, what?

Do you have any suggestions to improve either the function or appearance of your prosthesis? Yes/No
If Yes, what?

Remarks:

Place:

Date:

Name of person taking interview

REFERENCES

- BUGEL, H. J., CARLSON, R. I. (1961). A study of the lower extremity. *Am. J. Phys. Med.* **40**, 93-95.
- DAVIES, E. J., FRITZ, B. R., CLIPPINGER, F. W. (1970). Amputees and their prostheses. *Artif. Limbs.* **14** (2), 19-48.
- GLATTLY, H. W. (1964). Statistical study of 12,000 new amputees. *South. Med. J.* **57**, 1373-1378.
- KAY, H. W., NEWMAN, J. D. (1974). Amputee survey, 1973-74: preliminary findings and comparisons. *Orthot. Prosthet.* **28** (2), 27-32.
- KEGEL, B., CARPENTER, M. L., BURGESS, E. M. (1978). Functional capabilities of lower extremity amputees. *Arch. Phys. Med. Rehabil.* **59**, 109-120.
- KERSTEIN, M. D., ZIMMER, H., DUGDALE, F. E., LERNER, E. (1974). Amputations of lower extremity: a study of 194 cases. *Arch. Phys. Med. Rehabil.* **55**, 454-459.
- NARANG, I. C., JAPE, V. S. (1982). Retrospective study of 14,000 civilian disabled (new) treated over 25 years at an Artificial Limb Centre. *Prosthet. Orthot. Int.* **6**, 10-16.
- SILVERSTEIN, M. J., KADISH, L. (1973). A study of amputations at lower extremity. *Surg. Gynecol. Obstet.* **137**, 579-580.
- STERN, P. H. (1976). Assessment of amputee rehabilitation using a text generating data processing system. *Orthot. Prosthet.* **30** (2), 31-42.