Prosthetics and Orthotics International, 1988, 12, 9–18

Lower limb amputations in Southern Finland 1984–1985

T. POHJOLAINEN and H. ALARANTA

Invalid Foundation Orthopaedic Hospital, Helsinki, Finland

Abstract

To assess the current epidemiological situation concerning lower limb amputations in southern Finland the data on all amputations made in the catchment area of the Helsinki University Central Hospital were analysed for the period 1984–85. During the two-year period, 880 amputations of lower limbs were performed on 705 patients. The amputation rate was 32.5 per 100,000 inhabitants in 1984 and 28.1 in 1985. Patients requiring amputation were arteriosclerotics in 43.1 per cent. and diabetics in 40.7 per cent. Diabetics underwent amputation 3 years younger on average than the arteriosclerotics. The most common site of unilateral amputations was above-knee (42.0 per cent) followed by below-knee (27.7 per cent) and toe amputations (22.2 per cent). The level of amputation tended to become more proximal with increasing age of the patients. The overall mortality figure during three postoperative months was 27.0 per cent. Amputation incidence increased sharply with increasing age. On the base of predictions, the overall age structure of the Finnish population will shift upward causing an increase in the proportion of elderly age groups. A 50% increase in amputation rate is expected in Finland within the next 20–30 years.

Introduction

In the last few years, there has been an increase in the number of amputations in Scandinavia and other Western countries (Hansson, 1964; Lindholm, 1964; Tibell, 1971; Kihnm et al., 1972; Hierton & James, 1974; Mooney et al., 1976; Liedberg & Persson, 1983). Vascular insufficiency is a major cause of peace-time amputations of the lower limbs. Amputations resulting from end-stage peripheral vascular diseases are an increasingly common health problem (Mooney et al., 1976; Fleurant & Alexander, 1980; Bodily & Burgess, 1983). Although advances in peripheral vascular surgery have salvaged a great number of limbs, many arterial occlusions in lower extremities are still irreversible, and amputation remains the only answer if arterial reconstruction is not possible or has failed (Finch et al., 1980). New, refined or alternative methods of treatment of osteomyelitis, neoplastic tumours and traumatic conditions have lessened the need for amputations in these conditions (Vilkki & Göransson, 1982; Chen & Zeng, 1983; Vilkki, 1986).

Despite the extensiveness of Finnish medical statistics compiled by the National Board of Health, no regular reports are available on the number and types of amputations performed nor on the constitution and size of the amputee population. There are no general official statistics on the number and types of prostheses prescribed in Finland. In Scandinavia, there is an amputation register in Denmark (Ebskov, 1983; Ebskov, 1986), and in Sweden Hansson (1964) has published a well-documented study on the amputee population.

There is a specific requirement for amputee statistics for the planning of prosthetic rehabilitation of amputee patients and the evaluation of future needs in personnel, facilities and funds. To assess the current epidemiological situation concerning amputations in southern Finland, the data on all limb amputations made in the catchment area of the Helsinki University Central Hospital were collected for the period 1984–1985. The purpose of the study was to determine the incidence, causes and levels of lower limb amputations.

Material and methods

The catchment area of Helsinki University Central Hospital (HUCH) had a population of 1,159,000 in 1984 and 1,171,000 in 1985.

All correspondence to be addressed to Mr. T. Pohjolainen, Invalid Foundation Orthopaedic Hospital, Tenholantie 10,00280 Helsinki, Finland.

corresponding to 24 per cent of the population of Finland. A total of 82.9 per cent of the population under study lived in 14 cities and 17.1 per cent in rural areas.

The HUCH catchment area includes 16 surgical hospitals where amputations can be performed. During the period 1984–85 data concerning amputees in all the 16 operative units were collected. Every patient's hospital record was examined thoroughly with any data concerning demographic factors, diagnoses, amputation levels and postoperative complications being recorded manually. Mortality and times of death were investigated in collaboration with the national Social Insurance Institution. All the collected data were computerized for analysis.

Results

During the two-year period, 880 amputations of the lower limbs were performed on 705 patients. Of the 705 patients, 382 (54.2 per cent) were female and 323 (45.8 per cent) male. The amputation rate was 32.5 per 100,000 inhabitants in 1984 and 28.1 in 1985. Some 29.3 and 25.0 per 100,000 of the population underwent an amputation for the first time in 1984 and 1985, respectively. Lumbar sympathectomy, vascular reconstructive operation, arterial embolectomy, trombendarterectomy or a combination of these preceded the amputation in the case of 168 patients, corresponding to 23.8 per cent of all the amputees and 27.1 per cent of vascular amputees.

A total of 73 patients (10.4 per cent) had undergone an amputation prior to 1984 at a lower level or in the contralateral limb. Of these 73 patients, 72 were amputated because of vascular disease. Of the latter, 40 (54.8 per cent) were diabetics, 30 (41.1 per cent) arteriosclerotics and 2 (2.7 per cent) had Buerger's disease. There were 27 (37 per cent) above-knee amputations, 33 (45.2 per cent) below-knee amputations and 13 (17.8 per cent) metatarsal or toe amputations.

Diagnosis, sex and age

Obliterative arteriosclerosis was the diagnosis of 591 amputees (83.8 per cent). Of the 705 patients of the study, 304 (43.1 per cent) had arteriosclerosis without diabetes and 287 (40.7 per cent) had diabetic microangiopathy (Table 1). Vascular insufficiency resulting from embolic disease was the primary cause of amputation in 27 patients and Buerger's diseases in three patients. Tumours were the cause in 17 cases, trauma in 14 cases and frostbite in 31 cases. A total of 17 amputations were performed for other reasons.

Diagnosis, age and sex distributions of the

Table 1. Diagnosis and mean age of amputees at the time of first amputation

Diagnosis	Amputees				Age (years)					
	Women	Men	Total	Per cent of diagnoses	Women $\bar{x}$	SD	Men $\bar{x}$	SD	Total $\bar{x}$	SD
Arteriosclerosis without diabetes	149	155	304	43.1	79.6	8.4	71.0	10.7	75.0	11.2
Arteriosclerosis with diabetes	187	100	287	40.7	74.8	10.0	66.9	12.7	72.0	11.6
Frostbite	4	27	31	4.4	47.5	19.8	51.3	13.6	50.8	14.2
Embolism	19	8	27	3.8	73.1	10.8	67.4	4.8	71.4	9.6
Tumour	8	9	17	2.4	50.4	23.9	29.4	23.4	39.3	25.6
Trauma	5	9	14	2.0	43.6	26.3	39.4	18.9	40.9	20.9
Deformity	6	3	9	1.4	71.8	10.0	54.0	30.0	65.9	19.1
Osteomyelitis	1	5	6	0.9	87.0		59.8	19.6	63.3	20.7
Buerger's disease		3	3	0.5			44.0	8.7	44.0	8.7
Vasculitis	2		2	0.3	38.0	2.8			38.0	2.8
Artery aneurysm		2	2	0.3			74.5	3.5	74.5	3.5
Congenital deformity		1	1	0.1			4.0		4.0	
Chronic ulcer		1	1	0.1			73.0		73.0	
Total	382	323	705	100.0						

amputees are shown in Table 2. Most of the arteriosclerosis patients, 73 per cent, were over 70 years of age. The proportion of under 70-year-olds was 14.1 per cent among the female and 39.4 per cent among the male arteriosclerotic patients. The largest arteriosclerotic amputation group, 39.8 per cent, were the over 80-year-olds. Most of the diabetics, 61.3 per cent, were amputated at the age of 60-79 years. Among the diabetics, 23.5 per cent of the female and 55 per cent of the male patients underwent amputation before the age of 70. Patients undergoing amputation for embolism were mostly (92.6 per cent) over 60 years of age. Men dominated among traumatic amputees. The majority of traumatic amputees, 11 patients (78.6 per cent), were younger than 60. After vascular disease the second most common reason for amputation was frostbite. The patients amputated for frostbite were mostly men (87.1 per cent) and the largest group, 48.4 per cent, were the 50–59-year-olds. Patients amputated for tumours were encountered mostly in the younger age groups, with 76.5 per cent being amputated before the age of 60. Of all the 20 patients amputated before the age of 30, 40 per cent were amputated for tumours, 25 per cent for trauma, 15 per cent for frostbite, 15 per cent for deformities and one person for diabetic complications.

The diabetics as a rule were somewhat younger at the time of amputation than were those with arteriosclerotic gangrene. The mean age was 72 years for diabetics and 75 years for non-diabetics (Table 1). The proportion of men and women was equal in the group of arteriosclerotic gangrene amputees, while in the group of diabetics the majority were women. The male diabetics and non-diabetics were distinctly younger than the corresponding female groups.

Patients who underwent amputation for embolism did not differ much in age from the arteriosclerotic and diabetic patients. Only two persons amputated for embolism were under 80 years of age. Embolectomy preceded amputation in the case of 14 patients.

Amputees with tumours and trauma were considerably younger than average, their mean ages being 39.3 years and 40.9 years, respectively (Table 1). The mean age of the two women with LED vasculitis was 38 years. The mean age of the three men with Buerger's disease was 44 years.

Figure 1 shows the distribution of amputees according to age. The proportion of the total number of amputees in each age group increased progressively up to the 70–79-year-group. The latter constituted the largest ten-year cohort, representing 33.6 per cent of all the 705 amputees. More amputations were performed on males than on females in all age groups under 60 years; but females formed the majority among amputees over 70 years of age. The overall ratio of men to women in the entire material (705) was 0.8.

The annual incidence of amputations was also estimated in relation to the population of

Table 2. Diagnosis, age and sex of amputees

Cause of amputation	n	Men/Women	Age at time of amputation (years)				
			0–49	50–59	60–69	70–79	80–
Arteriosclerosis without diabetes	304	155/149 = 1.0	6	25	51	101	121
Arteriosclerosis with diabetes	287	100/187 = 0.5	18	13	68	108	80
Frostbite	31	27/4 = 6.8	9	15	2	5	
Embolism	27	8/19 = 0.4	1	1	8	14	3
Tumour	17	9/8 = 1.1	10	3	1	2	1
Trauma	14	9/5 = 1.8	8	3	2	1	
Deformity	10	4/6 = 0.7	3	2	1	3	1
Osteomyelitis	6	5/1 = 5.0	1		3		2
Buerger's disease	3	3/0	2	1			
Miscellaneous	6	3/3 = 1.0	1	1	1	3	
Total	705	323/382 = 0.8	59	64	137	237	208
Per cent			8.4	9.1	19.4	33.6	29.5

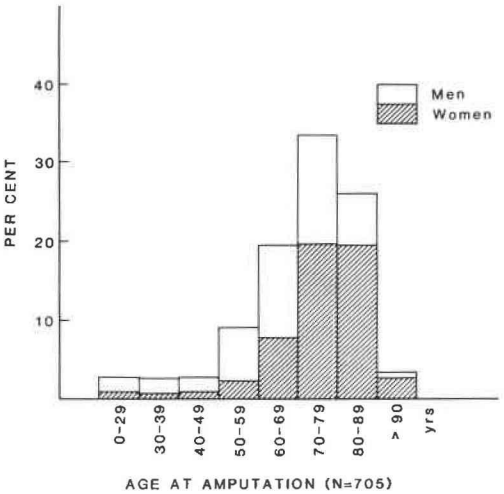

Fig. 1. Proportions of different age groups and sex among the amputees.

different age groups in the study area. No significant differences in incidence were found between males and females. A logarithmic increase in the frequency of amputations was noted with increasing age (Fig. 2). The annual incidence of new amputations in the over-80 age group exceeded 400 per 100,000 inhabitants in both sexes.

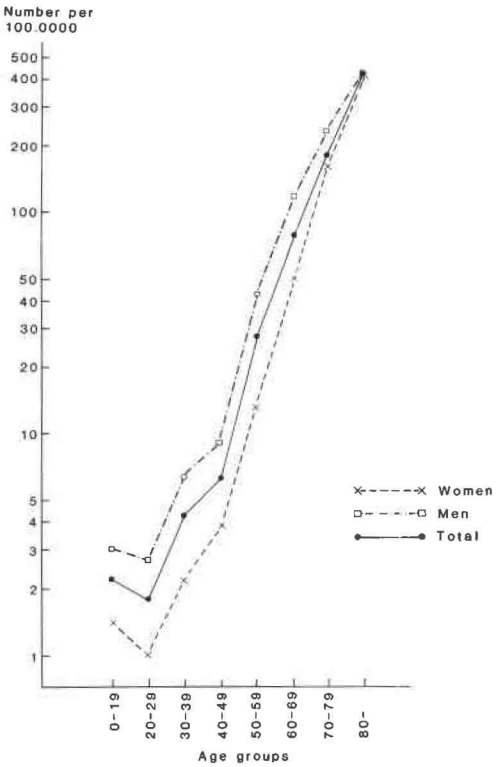

Fig. 2. Annual incidence of amputation in different age groups (logarithmic scale).

Levels of amputation

Two-thirds of all the amputations were performed at a level requiring a prosthesis: at the thigh, shank, ankle or foot. There were 841 unilateral (95.6 per cent) and 39 bilateral (4.4 per cent) amputations. The most common unilateral amputations regarding site were the above-knee amputations (42.0 per cent) followed by below-knee (27.7 per cent) and toe amputations (22.2 per cent) (Table 3). Of the 195 toe amputations, two-thirds required amputation of only one toe. Other types of amputations were quite rare.

Table 3. Distribution of 841 unilateral amputations according to level of amputation.

Type of amputation	Number of amputations	Per cent
Hemipelvectomy	1	0.1
Hip disarticulation	8	0.9
Above-knee	353	42.0
Below-knee	233	27.7
Syme	4	0.5
Chopart and Pirogoff	3	0.4
Lisfranc	11	1.3
Transmetatarsal	33	3.9
Toe amputation	195	23.2
Total	841	100.0

The level of amputation tended to become somewhat more proximal with increasing age of the patients (Fig. 3). Amputation level was also correlated with diagnosis and cause of amputation. Tumours at a young age often appeared to be associated with above-knee amputations. Of the 17 tumour patients, 13 (76.5 per cent) had above-knee amputation, one had hemipelvectomy, one had hip joint disarticulation, one had below-knee amputation and one had toe amputation. Of the 14 traumatic amputations, only three (21.4 per cent) were above-knee. Some 61.7 per cent of the female arteriosclerotic patients and 36.9 per cent of female diabetics were amputated above-knee. The corresponding figures for men were 51 and 28 per cent. The group of 27 embolic patients included 19 (70.4

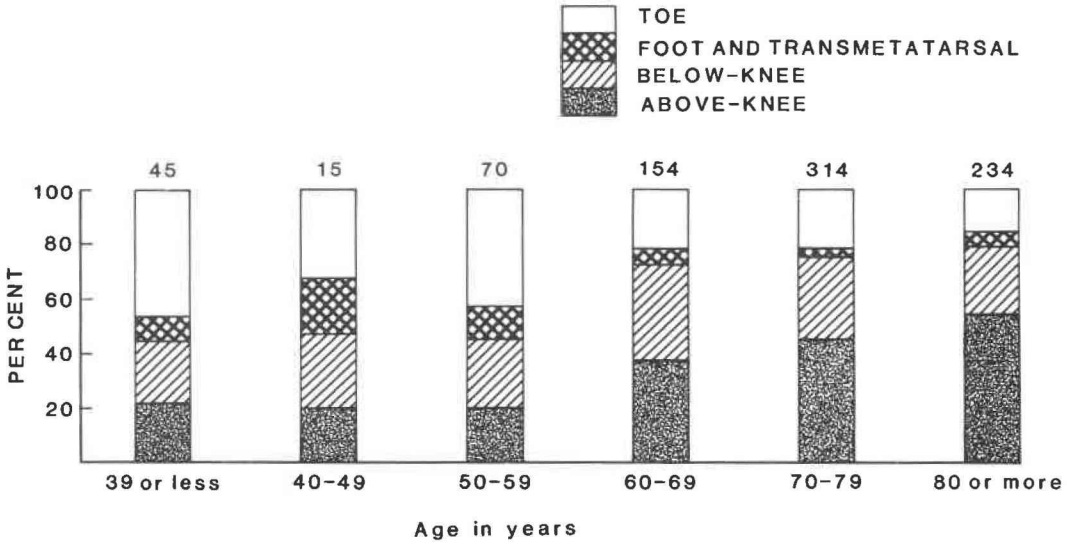

Fig. 3. Level of amputation in relation to age in 832 unilateral amputations (one unilateral hemipelvectomy and eight unilateral hip disarticulations not included).

per cent) unilateral above-knee amputations and one hip joint disarticulation, six below-knee amputations and two bilateral above-knee amputations.

Bilateral amputations

Concurrent bilateral amputation was performed on 39 patients (Table 4), 25 men and 14 women. Among these bilateral amputees, the 70–79-year-group was the most numerous with 12 patients, followed by the 50–59-year-group with 11 amputees. There were five patients younger than 50: one woman amputated for LED vasculitis and four men amputated for frostbite. The largest group according to site were the bilateral toe amputees with 12 patients, followed by a group of nine bilateral above-knee amputees. The cause of bilateral amputation was peripheral vascular disease in 20 patients (51 per cent). Diabetic gangrene was the cause in eight and arteriosclerotic gangrene in 12 patients. Frostbite was the cause of a bilateral amputation in 15 patients (38.5 per cent). Other causes included embolism in two patients, LED vasculitis in one patient and chronic ulcer in one patient.

Table 4. Bilateral amputations

Type of amputation	n	Per cent
Above-knee/above-knee	9	23.1
Above-knee/below-knee	1	2.6
Below-knee/below-knee	5	12.8
Below-knee/toe	5	12.8
Tmt/tmt	7	17.9
Toe/toe	12	30.8
Total	39	100.0

Table 5 shows the situations of the 705 amputees at the end of 1985. Previous amputations, amputations during the study period, reamputations and contralateral amputations are included. There were 82.4 per cent unilateral and 17.6 per cent bilateral amputees.

Mortality

Of all the 705 patients, 127 (18 per cent) died during the postoperative hospitalization period. The immediate causes of death are shown in Table 6, indicating that the majority died because of cardiac (37.8 per cent) and pulmonary (27.5 per cent) diseases.

The overall mortality figure during three postoperative months was 190 (27 per cent). A total of 135 patients died during the first month, 31 during the second month and 24 during the third month.

Only five (2.6 per cent) of the deceased patients were under 60; three of these were male arterio-sclerotics, one a male and one a female diabetic. All five died within the first postoperative month.

A total of 187 (98.4 per cent) of the 190 patients who died during the first three months

Table 5. Amputation levels of the 705 amputees at the end of the study period.

Type of amputation	n	Per cent
Unilateral		
Above-knee	288	40.9
Below-knee	156	22.1
Toe amputation	110	15.6
Foot amputation[1)]	19	2.7
Hip disarticulation	7	1.0
Hemipelvectomy	1	0.1
Bilateral		
Above-knee/above-knee	41	5.8
Below-knee/below-knee[2)]	25	3.6
Above-knee/below-knee	23	3.3
Tmt/tmt[3)] or toe/toe	13	1.8
Below-knee/toe	11	1.6
Below-knee/foot	5	0.7
Above-knee/tmt	3	0.4
Foot/toe	2	0.3
Hip disarticulation/ aboveknee	1	0.1
Total	705	100.0

1) Includes Pirogoff, Chopart, Lisfranc and transmetatarsal amputations.
2) Includes one Syme/Syme amputation.
3) Tmt = transmetatarsal.

were amputated for vascular insufficiency. Patients who died within three months of the amputation comprised 95 (50 per cent) arteriosclerotic and 79 (41.6 per cent) diabetic gangrene amputees, 12 (6.3 per cent) embolic amputees, one tumour amputee, one patient was amputated for aortic aneurysm, one for chronic bilateral leg ulcer and one for leg deformity. Of the 95 arterio-sclerotics, 50 (52.6 per cent) were female and 45 male (47.4 per cent). Of the 79 diabetics, 56 (70.9 per cent) were female and 23 (29.1 per cent) male. All the 12 deceased amputees with embolism were female and 11 of them died during the first month. Thirty (24.2 per cent) of the 124 patients amputated bilaterally died during the first three months.

In the group of arteriosclerotics who died postoperatively, 64 (67.4 per cent) had undergone above-knee amputation, nine (9.5 per cent) below-knee amputation and eight (8.4 per cent) bilateral amputation. For the deceased diabetics, the amputation level was above-knee in 34 (44.3 per cent) and below-knee in 20 (25.3 per cent) cases; bilateral amputation was done in 20 (25.3 per cent) cases. Other amputations were distal ones. The deceased embolic patients had been amputated above-knee in eight (66.7 per cent) and below-knee in two cases; there was one hip jont disarticulation and one bilateral above-knee amputation.

Table 6. Causes of death during hospitalization.

Cause of death	n	Per cent
Myocardial infarction	27	21.3
Other heart disease	21	16.5
Pneumonia	21	16.5
Pulmonary embolus	14	11.0
Septicaemia	10	7.9
Gangrene of lower limb	7	5.5
Cerebrovascular	4	3.2
Diabetes mellitus	2	1.6
Other causes	14	11.0
Unknown	7	5.5
Total	127	100.0

Discussion

Any conclusions drawn from the foregoing data are, strictly speaking, valid only regarding the catchment area of the Helsinki University Central Hospital. The criteria for amputation applied by different hospitals may vary; also, the rate of amputation will be affected by the age distribution and geographic background. The study area and whole of Finland are quite similar in demographic structure. In the study area, the proportion of under 60-year-olds was 83.8 per cent, that of 60-69-year-olds 8.1 per cent and that of over 70-year-olds 8.1 per cent at the time of study. The corresponding figures for the whole of Finland were 82.5, 8.9 and 8.6 per cent. This close demographic similarity allows some nationwide conclusions to be drawn from the results presented here.

The rate of amputations has clearly increased in the studied area compared with 1972. In 1972, 190 lower limb amputations were done on 151 patients in the same area (Solonen et al., 1973), whereas in 1984 and 1985, the number of amputees was 376 and 329, respectively. These figures correspond to an amputee rate of 15.2 per 100,000 inhabitants in 1972, 32.5 in 1984 and 28.1 in 1985. These yearly incidences are in the same order as that reported for Malmöhus County in Sweden, where the incidence was

32.0 per 100,000 inhabitants in 1979 (Liedberg & Persson, 1983). In 1970, the number of lower limb amputations was estimated at 800 for the whole of Finland (Solonen et al., 1973). Similarly, the incidence for 1984–85 reported here corresponds to a national total of 1,592 amputations in 1984 and 1,375 in 1985.

In Finland, the proportion of over 60-year-olds has increased between 1970 and 1984 – 1985. In 1970, 75 per cent of all lower limb amputees were over 60 years of age (Solonen et al., 1973) whereas in 1984–85 85 per cent of all lower limb amputees and 89 per cent of vascular amputees were over 60 years old. In Alffram & Holmquist's (1961) series in Sweden, 76.5 per cent of amputees were over 60 years old. In their survey, Finch et al. (1980) reported 89 per cent as the corresponding figure in British population. In Finland, in 1970 the proportion of 60-69-year-olds among lower limb amputees was 29 per cent, that of the 70–79 age group 31 per cent and that of the over-80 age group 15 per cent (Solonen et al., 1973). The figures for 1984–85 were 19.4 per cent, 33.6 per cent and 29.5 per cent, respectively.

Figure 2 illustrates the sharp increase of amputation incidence with increasing age. Most of the demonstrated overall increase in amputation rate is explained by increases in the older age groups, by the growing number of gangrene amputees as well as by the increase in the incidence of vascular diseases often making amputation unavoidable. The proportion of elderly amputees has increased during the last 40 years in the Western countries (Table 7). It is predicted that the overall age structure of the population will continue to shift upward causing an increase in the proportion of elderly age groups (data supplied from the Central Statistical Office of Finland). On the base of these predictions and the observed amputee incidence in different age groups in 1984-85, an estimate of the future trend in the number of amputations in the whole of Finland is drawn up in Figure 4. The increase in the proportion of the over-60 population will be responsible for an increase in amputation rate because the risk of becoming an amputee rises with increasing age (Hansson, 1964; Fleurant & Alexander, 1980; Borssén & Lithner, 1984). It is conceivable, however, that the future increase in amputations may turn out to be even higher than that estimated on the basis of demographic changes (Liedberg & Persson; 1983).

Table 7. Proportion of patients aged 80 or older among those amputated for vascular diseases.

Period	Authors	n	Proportion
1949–59	Alffram & Holmquist	125	0.08
1947–61	Hansson	261	0.19
1950–63	Vankka	184	0.12
1961–71	Christensen	326	0.18
1965–71	Weaver & Marshall	105	0.14
1973–77	Renström[1)]	200	0.27
1979	Liedberg & Persson	161	0.38
1984-85	Present study	621	0.33

1) Below-knee amputations only.

According to Western statistics, over 80 per cent of all lower limb amputations result from complications of peripheral vascular diseases (Alffram & Holmquist, 1961; Hansson, 1964; Kihn et al., 1972; Fleurant & Alexander, 1980; Helm et al., 1986). In this study vascular diseases were found to be the cause of amputation in 88 per cent of patients. This proportion has increased compared with 1970

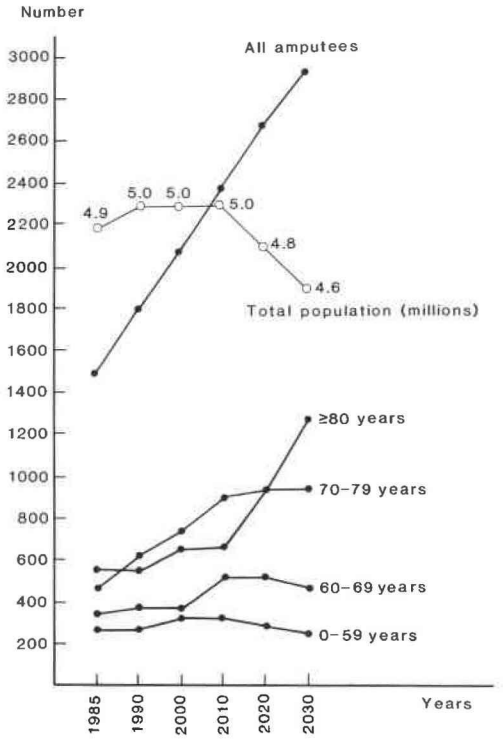

Fig. 4. Future trend in the number of amputees and separately in different age groups in the whole of Finland estimated on the basis of the age-related incidences in the study area in 1984–85. Predicted Finnish population is also shown.

when 75 per cent of amputations were caused by vascular insufficiency (Solonen et al., 1973). Arteriosclerosis has been found to be the dominating cause of amputations in patients with vascular disease (Warren & Kihn, 1968; Burgess et al., 1971; Christensen, 1976; Helm et al., 1986), as also in this study. In Sweden, the United States and Singapore diabetic microangiopathy has been the most common diagnosis (Table 8). The proportion of diabetes as the cause of amputation in Finland does not differ from that found in other Western countries. The possibility cannot be ruled out, however, that some patients with arteriosclerosis may become included in the embolism group and vice versa because the emboli can complicate primary arteriosclerosis. There was a decrease between 1970 and 1984–85 in the relative number of victims of accidents. In 1970, trauma caused 12 per cent of all amputations (Solonen et al., 1973) whereas the corresponding figure was only 2 per cent in 1984–85. The decrease in the number of amputations due to trauma may be largely explained by improved industrial safety, and also by the advance in replantation surgery (Cheng & Zeng, 1983; Øestrup & Vilkki, 1986).

The age of amputated diabetic gangrene patients was lower than that of arteriosclerotic gangrene patients, a situation also observed in Swedish studies (Hansson, 1964; Christensen, 1976). An even more pronounced age difference was found between female and male arteriosclerotic and diabetic gangrene patients.

Table 8. Proportion of diabetics among patients amputated for vascular diseases.

Period	Authors	n	Proportion
1947–61	Hansson	269	0.53
1949–59	Alffram & Holmquist	125	0.49
1959–65	Lindahl & Bolund	183	0.40
1961–71	Christensen	326	0.46
1964–70	Burgess et al.	193	0.52
1967–69	Hierton & James	94	0.60
1965–71	Weaver & Marshall	105	0.31
1966–71	Persson & Sunden	143	0.37
1971–73	Mooney et al.[1)]	190	0.66
1973–77	Renström[1)]	183	0.54
1974–78	Finch et al.	133	0.32
1976–79	Helm et al.	231	0.24
1979	Liedberg & Persson	161	0.37
1978–80	Tan et al.	262	0.59
1984–85	Present study	621	0.46

1) Below-knee amputations only.

The degree of male dominance among amputees varies according to the age distribution of patients studied. Series of younger amputees show a more marked preponderance of men (Jansen, 1960; Hirch, 1961). In this study, too, men dominated in age groups younger than 70 with a proportion of 67 per cent, whereas women were in majority among the over 70-year-olds with a proportion of 66 per cent. In the 30–39 age group amputation was three times as common among men as among women, but the situation was reversed in the over-80 group. During the last 50 years, there has been no significant change in the sex ratio of amputated because of ischaemia (Table 9). The fact that the majority of younger amputees are men may reflect the earlier onset of arteriosclerosis in men. Traumatic and frostbite amputations are more common among men than among women.

The amputation level shifted in the proximal direction with increasing age of the patients.

A comparison between the years 1984–85 and 1970 shows a decrease in above-knee amputations. In 1970, 71 per cent of all amputations were above-knee and 19 per cent below-knee amputations (Solonen, 1973). During the period of the present study, 42.0 per cent of the above-knee amputations and 27.7 per cent of the below-knee amputations were unilateral. Taking into account previous amputations and reamputations, 40.9 per cent of all the 705 amputees underwent unilateral amputation above-knee, 22.1 per cent unilateral amputation below-knee and 17.6 per cent bilateral amputation. The proportion of above-knee amputations was, however, higher in this study than in series studied by Alffram & Holmquist (1961), Mooney et al. (1976), Finch et al. (1980) or Steinberg (1985), in which the proportion of above-knee amputations was 26–36.6 per cent.

Table 9. Proportion of men among patients amputated for vascular diseases.

Period	Authors	n	Proportion
1930–60	Lindholm	531	0.60
1947–61	Hansson	261	0.54
1950–63	Vankka	184	0.60
1967–69	Hierton & James	94	0.44
1967–72	Harris et al.	75	0.56
1973–77	Renström[1)]	200	0.53
1974–77	Finch et al.	133	0.60
1979	Liedberg & Persson	161	0.54
1984–85	Present study	621	0.43

1) Below-knee amputations only.

In the present study above-knee amputations were less common than in Denmark in 1961–71 (Christensen, 1976).

The need for saving the knee joint in an amputation must be balanced against the rising morbidity if healing of the stump cannot be achieved. The general status and local condition of the limb is equally important. If the patient is likely to be bedridden or moved with a wheelchair because of other diseases, a high amputation level may be chosen with a better healing prognosis.

The high mortality rate of 30.1 per cent during the first postoperative months among amputees with vascular diseases bears testimony of advanced state of the disease. This is also indicated by the fact that 11.3 per cent of patients amputated for ischaemia had undergone a prior amputation, 27.0 per cent of those amputated for vascular disease had a history of sympathectomy, reconstructive surgery, embolectomy or a combination of these. Along with the advances of reconstructive surgery for limb salvage patients coming into hospitals are older than previously and have a more advanced generalized vascular disease. The mortality during hospitalization found in this study was higher than that reported by other investigators (Weaver & Marshall, 1973; Harris et al., 1974; Coch et al., 1977; Finch et al., 1980). The rate of death (27 per cent) within three months following initial surgery was higher than in Denmark 16.6 per cent (Ebskov & Josephsen, 1980). This difference may be partly due to the higher mean age of the present series compared with earlier studies.

Acknowledgements

The study was granted from Professor Langenskiöld Fund delivered by the Factory of Prosthetic Foundation, Helsinki.

REFERENCES

Alffram, P. A., Holmquist, P. (1961) Amputationer på nedre extremiteten. *Nord. med.* **65,** 356–359.

Borssén, B., Lithner, F. (1984) Amputations in diabetics and nondiabetics in Umeå County 1971 – 1977. *Acta Med. Scand. [Suppl.]* **687,** 95–100.

Bodily, K., Burgess, E. (1983). Contralateral limb and patient survival after leg amputation. *Am. J. Surg.* **146.** 280–282.

Burgess, E. M., Romano, R. L., Zettl, J. H., Schrock, R. D. (1971) Amputations of the leg for peripheral vascular insufficiency. *J. Bone Joint. Surg.* **53-A,** 874–890.

Chen, Z. W., Zeng, B. F. (1983). Replantation of the lower extremity. *Clinics Plastic Surg.* **10,** 103–113.

Christensen, S. (1976) Lower extremity amputations in the county of Aalborg 1961–1971. *Acta Orthop. Scand.* **47,** 329–334.

Couch, N. P., David, J. K., Tilney N. L., Crane, C. (1977) Natural history of the leg amputee. *Am. J. Surg.* **133,** 469–473.

Ebskov, B., Josephsen, P. (1980) Incidence of reamputation and death after grangrene of the lower extremity. *Prosthet. Orthot. Int.* **4,** 77–80.

Ebskov, B., (1983). Choice of level in lower extremity amputation – nationwide survey. *Prosthet. Orthot. Int.* **7,** 58–60.

Ebskov, B. (1986). The Danish amputation register 1972–1984. *Prosthet. Orthot. Int.* **10,** 40–42.

Finch, D., MacDougal, M., Tibbs, D., Morris, P. (1980). Amputation for vascular disease: the experience of a peripheral vascular unit. *Br. J. Surg.* **67,** 233–237.

Fleurant, F., Alexander, J. (1980). Below-knee amputation and rehabilitiation of amputees. *Surg. Gynecol. Obstet.* **151,** 41–44.

Hansson, J. (1964). The leg amputee: a clinical follow-up study. *Acta Orthop. Scand.,* [Suppl.] **69.**

Harris, P. L., Read, F., Eardley, A., Charlesworth, D., Wakefield, J., Sellwood, R. A. (1974). The fate of elderly amputee. *Br. J. Surg.* **61,** 665–668.

Helm, P., Engel, T., Holm, A., Kristiansen, V. B., Rosendahl, S. (1986). Function after lower limb amputation. *Acta Orthop. Scand.* **57,** 154–157.

Hierton, T., James, U. (1973). Lower extremity amputation in Uppsala County 1947–1969: Incidence and prosthetic rehabilitation. *Acta Orthop. Scand.* **44,** 573–582.

Jansen, K. (1960). Amputation : frequency and cause. In Prosthetics International; proceedings of the Second International Prosthetics Course, 30 July – 8 August, 1959 – Copenhagen: ISWC, 1960. pp 105–107.

Kihn, R., Warren, R., Beebe, G. (1972). The "geriatric" amputee. *Ann. Surg.* **176,** 305–314.

Liedberg, E., Persson, B. M. (1983). Increased incidence of lower limb amputation for arterial occlusive disease. *Acta orthop. Scand.* **54,** 230–234.

Lindahl, F., Bolund, S. (1969). Amputationer på underekstremiteterna. Ugeskr. Laeger **131,** 365–368.

Lindholm, R. (1964). Features of amputation surgery among civilians during period 1930–1960. *Acta Orthop. Scand.* **35,** 74–89.

Mooney, V., Wagner, W., Waddell, J., Ackerson, T. (1976). The below the knee amputation for vascular disease. *J. Bone Joint. Surg.* **58-A,** 365–368.

Østrup, L. T., Vilkki, S. K. (1986). Reconstructive microsurgery – a review. *Acta Orthop. Scand.* **57,** 395–401.

Persson, B., Sunden, G. (1971). Amputation på underbenet vid åldersgangrän. *Nord. Med.* **86,** 1045–1049.

Renström, P. (1981). The below-knee amputee. Thesis. University of Gothenburg, Sweden.

Solonen, K., Lindqvist, C., Malmelin, P-E., Niemi, V., Salokangas, J., Ailio, R. (1973). Apuneuvohuolto ja sen kehittäminen, 42–57.

Steinberg, F. V., Sunwoo, J., Roettger, R. F. (1985). Prosthetic rehabilitation of geriatric amputee patients: a follow-up study. *Arch. Phys. Med. Rehabil.* **66,** 742–745.

Tan, M. H., Gwee, H. M., Yeo, P., Lim. P., Bose, K. (1983). Diabetic amputee in Singapore. Tokohu *J. Exp. Med., Suppl.* 141.

Tibell, B. (1971). Peripheral arterial insufficiency. *Acta Orthop. Scand., Suppl.* 139.

Vankka, E. (1967). Study on arteriosclerotics undergoing amputations. *Acta orthop. Scand.*, [Suppl.] 104.

Vilkki, S., Göransson, H. (1982). Traumatic amputations and the need for a replantation service in Finland. *Ann. Chir. Gynaec.* **71,** 2–7.

Vilkki, S. (1986). Replantation of a leg in an adult with 6-years' follow-up. *Acta Orthop. Scand.* **57,** 447–449.

Warren, R., Kihn, R. (1968). A survey of lower extremity amputation for ischaemia. Surgery **63,** 107–120.

Weaver, P., Marshall, S. (1973). A functional and social review of lower-limbs amputees. *Br. J. Surg.* **60,** 732–737.