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LOWER EXTREMITY AMPUTATION IN UPPSALA COUNTY 1947-1969. INCIDENCE AND PROSTHETIC REHABILITATION

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In published reports of statistical nature on amputations and rehabilitation, the data given vary considerably. This seems to be due to the fact that some figures have been based on the total number of amputations during a certain period, whereas other estimates have been made from the number of amputees still alive in a given population, or from the number of patients supplied with a prosthesis. In the latter case trauma predominates as the reason for the amputation. Such patients usually have a long expectation of life and have higher demands on prosthetic function and service. Totally, however, the great majority of amputations are performed for ischaemia and gangrene. There is general agreement that the frequency of obliterative arterial diseases as a reason for amputation is on the increase, and it is especially the higher age groups that are affected (Alffram & Holmquist 1961, Hansson 1964, Tibell 1971, Committee on Prosthetic-Orthotic Education 1971, Hierton & James 1972).

We here present a survey of all amputations performed in our own county during certain years in order to obtain current figures elucidating the frequency, cause and level of amputation, the age at amputation and survival time and the time interval between amputation and fitting with a prosthesis.

MATERIAL AND DEFINITIONS

The survey is based on amputations performed in Uppsala County in 1947, 1957, 1967, 1968 and 1969. The information was obtained from case records from the Uppsala University Hospital, Enköping Hospital, Samaritan Hospital in Uppsala and Tierp Hospital, i.e. all hospitals in the county.

Above-knee amputation refers to the levels between knee and hip disarticulation.

Table 1. Occurrence of amputations in Uppsala County during the years in question. The amputation frequency is given totally per 100,000 of the whole population and also for vascular disease per 100,000 inhabitants > 60 years of age.

Uppsala county year	No. of amputations				
	total	frequency per 10 ⁵ inhabitants	due to other reasons than vascular disease	due to vascular disease	frequency per 10 ⁵ inhabitants > 60 yrs
1947	16	10.7	6	10	43
1957	19	11.5	5	14	49
1967-69 (mean value)	34	17.1	2.3	31.3	85
Change	+ 110 %		- 60 %	+ 213 %	

Below-knee amputation refers to the levels from above the ankle joint to just below the knee. Amputation of the foot and toes is thus not included.

Fitting of prostheses has been in the hands of Een & Holmgrens Ortopediska AB, whose workshop in Uppsala and service have become attached by contract to the University Hospital. The gait training of the patients took place at the Amputee Training and Research Unit (*Gåskolan*) of the Department of Orthopaedic Surgery; this Unit is localized in the immediate vicinity of the Orthopaedic Workshop.

INCIDENCE 1947-1969

In 1947, when the population of Uppsala County was 150,000, 16 lower limb amputations were performed. The corresponding figures for 1957 were 164,000 and 19 respectively. In the three years 1967-1969 an average of 34 lower limb amputations per year were performed on a population of 196,000. Thus the increase in the number of amputations was considerably larger than the corresponding increase in population (Table 1). It was mainly the proportion of persons over 60 years of age that had increased in the county, and the increase in the number of amputations was mainly found in this part of the population.

If we look at the indications for amputation, it is, as expected, the vascular diseases that predominate. As seen in Table 1, there were 10 amputations for vascular disease in 1947, 14 in 1957 and an average of 31.3 per year in the three years 1967-1969. Simultaneous with this marked increase (213 per cent), other reasons for amputation had decreased in frequency. If the total number of amputations for the three compared periods is placed at 100 per cent, as in Figure 1, the proportion of reasons for amputation other than vascular diseases decreased from 40 to 7 per cent.

AMPUTATION FOR ISCHAEMIC DISEASE 1967-1969 (Tables 2-6)

Below-knee amputation was performed in 60 per cent and above-knee in 40 per cent. In the great majority of cases (84 per cent) the amputation was unilateral. Bilateral amputations thus occurred in 16 per cent. Of all amputations, 60 per cent

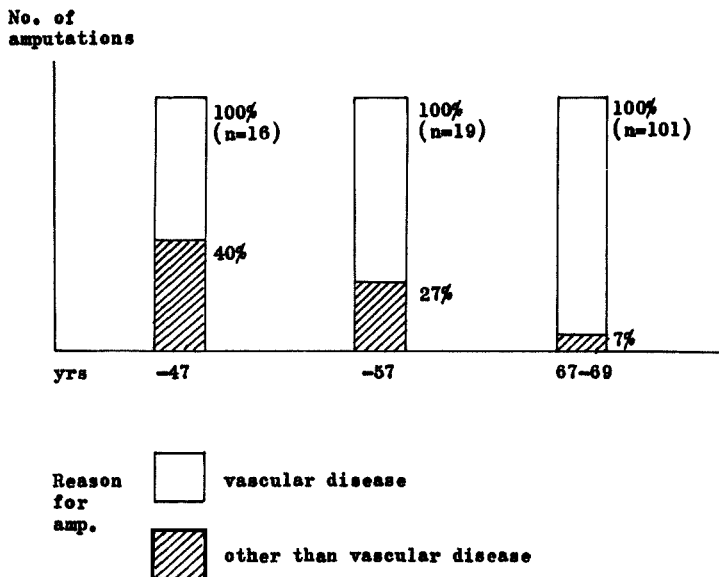


Figure 1. The proportion of vascular disease and conditions other than vascular disease as the reason for amputation in 1947, 1957, and 1967-1969.

occurred in diabetics. In these patients amputation below the knee was more common than above-knee amputation (Table 2).

Diagnosis, level and age

The youngest diabetics were 37, 43 and 48 years of age and had had their diabetes for 30, 22 and 12 years, respectively. They also had other severe manifestations of diabetes at the time of amputation. The mean age of the diabetics at the time of amputation was 72 years (Table 3).

The two youngest patients among the non-diabetics were one patient with Buerger's thromboangiitis obliterans—a 36-year-old man who sustained bilateral amputation and a 46-year-old man with severe arteriosclerosis obliterans. The mean age at amputation of the non-diabetics was 76 years (Table 3).

If the patient with Buerger's disease is excluded, the mean age is raised to 77 years.

The mean age of the above-knee amputees was 77 years and of the below-knee amputees 71 years (Table 3).

Survival

Just over half of the patients with amputations due to vascular disease were alive one year after the operation (Table 4).

Of the diabetic amputees, 30 per cent died within 3 months and 61 per cent lived for more than one year; of the non-diabetic amputees 24 per cent died within 3 months and 44 per cent lived for more than one year (Table 4).

Table 2. Amputations for vascular disease 1967-1969.

		Amputations	Per cent
Sex	women	53	56
	men	41	44
Diagnosis	diabetics	56	60
	non-diabetics	38	40
Level	above-knee	38	40
	below-knee	56	60
Laterality	unilateral	79	84
	bilateral	15	16

Revision and reamputation

A secondary operation was three times as common after below-knee as after above-knee amputation. At reamputation one-third of the below-knee amputees lost the knee joint, whereas half of the above-knee amputees lost the hip joint.

The reason for revision and reamputation was usually necrosis of the skin flap, of varying degrees of severity, or secondary infection. In one case rupture of the wound, necessitating a higher amputation level, occurred after knee joint disarticulation. With regard to both local revision and reamputation at a higher level, the frequency of diabetes was approximately the same as among the total number of amputations. 71 per cent of the patients who underwent a secondary operation were fitted with a prosthesis later—83 per cent after revision of the wound with retention of the primary amputation level and 63 per cent after reamputation.

Table 3. Amputations for vascular disease 1967-1969.

Diagnosis and level	No.	M (SD) range
Diabetics	56 (60 %)	72 (11) 37-89
Non-diabetics	38 (40 %)	76 (12) 36-93
Above-knee	38 (40 %)	77 (10) 36-91
Below-knee	56 (60 %)	71 (10) 43-93

No. = number of patients

M = mean age, years

SD = standard deviation

Table 4. Amputations for vascular disease 1967-1969.

Survival months	Diabetics	Non-diabetics	Total
< 3	17	9	26
3-12	5	12	17
>12	34	17	51
Total	56	38	94

Prosthetic rehabilitation after unilateral amputation (Table 5)

Approximately half of the patients were fitted with a prosthesis, 66 per cent of the below-knee amputees and 23 per cent of the above-knee amputees.

Concerning the time interval between amputation and fitting of the prosthesis, it was found that half of the below-knee amputees were fitted within 2 months, whereas none of the above-knee amputees were fitted within this short time. Within 2-4 months about 80 per cent of the unilateral below-knee amputees who were fitted had received their final prosthesis. The corresponding figure for the above-knee amputees was about 70 per cent. The remaining 20 per cent of the below-knee amputees and 30 per cent of the above-knee amputees who were fitted with a prosthesis needed more than 4 months.

An important factor in the fitting of the prosthesis was the patient's ability to put on and take off his prosthesis himself. Of 35 unilateral below-knee amputees supplied with a prosthesis only 7 needed the help of another person. Of the 6 unilateral above-knee amputees fitted with a prosthesis, no fewer than 5 needed help for putting it on.

Thirty of the 35 unilateral below-knee amputees fitted with a prosthesis were able to walk with the prosthesis without help of another person primarily, whereas only 3 of the 6 above-knee amputees were able to do so. The number of patients who could walk without the support of another person six months after the primary fitting was for the below-knee cases reduced to 26 and for the above-knee cases to 3 (deteriorated general condition, disease or death).

Bilateral amputation due to vascular disease

In this category there were more diabetics than non-diabetics. The time interval between the first and second amputation can be seen in Table 6.

The diabetic patients, who on the whole were somewhat older, showed rather more varying and longer intervals than the non-diabetics. The number are small, however, and the differences are not statistically significant.

Fewer than half of the patients who underwent bilateral amputation for vascular disease were fitted with a prosthesis and had some gait training. Two bilateral below-knee amputees were fitted with a prosthesis within two months. Both developed a good walking capacity and needed no help with putting on the prosthesis. They regained walking ability to a large extent. The combination of above- and below-knee amputation resulted in fairly good function in 4 out of 9 cases, whereas only one of the 3 patients with amputation at the thigh level on both sides, for vascular disease, had any appreciable value from his prostheses.

Table 5. Prosthetic rehabilitation of unilateral above-knee and below-knee cases amputated for vascular disease 1967-1969.

Level	Patients	Fitted with prosthesis	Time lag between amp and prosthetic fitting (months)			Able to put on prosthesis		Prosthetic walking ability		Use of prosthesis after primary fitting		
			<2	2-4	>4	without help	with help	primarily without help	6 months later without help			
Above-knee	26	6	-	4	2	1	5	3	3	1	3	12%
	100%	23%						12%				
Below-knee	53	35	18	10	7	28	7	30	4	26	2	28
	100%	55%						57%		49%		53%
Total	79	41	18	14	9	29	12	33	7	29	3	31
	100%	52%						41%		37%		39%

Table 6. Bilateral amputations for vascular disease 1967-1969. Time between amputation on first and second extremity and mean age for patients with and without diabetes.

Years	Diabetics No.	Non-diabetics No.
< 1	3	2
1-3	2	2
4-9	3	1
> 9	2	-
Total	10 67 %	5 33 %
Mean age, yrs	76 (66-88)	63* (36-79)

* If one 36-year-old patient with Buerger's disease is excluded, the mean age is 69 years (56-79).

DISCUSSION

The increase in the number of lower limb amputations between 1947 and 1969 which we have found in this investigation is in agreement with the reports of Hansson (1964) from Gothenburg and Tibell (1971) from Malmö. The growing proportion of elderly persons in the population, together with an increased frequency of ischaemic manifestations in these persons, is responsible for the raised amputation frequency. Amputations performed for other reasons, such as trauma and infection, have decreased in significance, due to improved methods of treatment of open fractures and infectious conditions.

With regard to obliterative arterial disease, it is true that arterial reconstructive methods can sometimes save an extremity from amputation, but among patients of higher ages with their often very extensive and advanced vascular changes, occasional cases successfully treated by this kind of surgery have had no effect on the statistical situation. It is important, however, that an amputation shall not always be regarded as a therapeutic failure. It may, on the contrary, constitute beneficial treatment at a certain stage of the patient's severe arterial disease—it can relieve him of pain and stinking gangrene and thereby rapidly improve his general condition. With modern postoperative treatment and prosthetic equipment even the very elderly patient may—with certain prerequisites—regain some degree of function and walking ability. Under optimum conditions amputation and subsequent

training with the prosthesis should be integrated and should thus be regarded as a reconstructive, not destructive measure.

Previously most surgeons recommended above-knee amputation for the treatment of gangrene due to obliterative arterial disease. They chose a high level in order to be sure of primary healing. Once amputation had been accomplished and wound healing had occurred, little interest remained for the problems involved in fitting a prosthesis and training the patient to independence. This lack of interest regarding the late post-surgical period could easily be understood—the rehabilitation potentials for the elderly AK-amputees were indeed not very encouraging. The fact was that very few elderly thigh amputees became independent walkers. This is general experience.

In the statistical study from Gothenburg from 1947–1969 Hansson (1964) found that above-knee amputation was more common than amputation below the knee. The same has been reported by other Scandinavian authors (Jansen 1960, Widolf 1961, Felländer et al. 1962, Lundholm 1963, Hallén & Hult 1964, Lindholm 1964, 1965, Vankka 1967, Lindahl & Bolund 1969).

Regarding rehabilitation potentials following amputation, general agreement has been reached that the integrity of the knee joint is one of the most important single factors. According to a statistical survey in 1965 made by the The National Board of Health and Welfare, the number of above-knee amputations performed in the Stockholm and Uppsala areas was about the same as the number of below-knee amputations. In the present survey, in Uppsala County in 1967–1969 the below-knee amputations were found to be in the majority. It is hoped that this trend will continue. We have put much emphasis during recent years on the concept that every effort should be made to preserve the knee joint.

Furthermore, the principle of rehabilitation—restoration to an optimum level of function in the shortest period of time—has gained recognition, and active interest has been focused on all aspects of the treatment of amputation patients (Hierton et al. 1967). Gradually the below-knee amputation has been accepted as the level of choice for gangrene. Even a short stump can be successfully fitted with a modern total contact prosthesis. More attention has also been directed towards the correct surgical technique for the amputation procedure and a careful handling of the tissues. It has been shown that an anterior flap should be avoided. Use of the long musculocutaneous posterior flap is safer in ischaemic cases. Suction drainage prevents haematoma. Careful

postoperative dressing—rigid or elastic—prevents oedema and facilitates ambulation. It has been shown that early prosthetic fitting stimulates all persons involved. Weight bearing on the non-healed ischaemic stump should, however, be avoided. We usually apply a plaster postoperatively to prevent flexion contracture and allow the patient to be ambulatory on crutches as soon as possible. In gait training suitable below-knee amputees are given a temporary prosthesis, with weight bearing on the ischial tuberosity and leaving the below-knee stump unsupported but protected by an elastic stocking (Hierton 1970, Hierton & James 1972).

In spite of the fact that additional handicaps are common among elderly amputees, often rendering them unsuitable for any gait training or prosthetic fitting, there is a considerable group of patients who will benefit from a well-organized orthopaedic rehabilitation programme. This should be characterized, among other things, by a short time lag between surgery and fitting of the prosthesis.

With modern techniques for making the prosthesis there should be practically no waiting period for the patient from the time the measurements are taken until the prosthesis is ready for the first fitting. In the present study of patients with amputations due to ischaemia, we found that about 50 per cent of the unilateral below-knee amputees who got a prosthesis were supplied within 8 weeks postoperatively and 80 per cent within 16 weeks. For the unilateral above-knee amputees a longer time postoperatively was necessary. For 70 per cent of them it took 16 weeks. None of the above-knee amputees were fitted within 2 months.

SUMMARY

A short survey is given of a statistical study on the incidence of lower limb amputation in Uppsala county 1947–1969. Amputations for vascular disease showed a marked increase in number.

In spite of the fact that additional handicaps are common among elderly amputees, often rendering them unsuitable for any gait training or prosthetic fitting, there is a considerable group of patients who will benefit from a well-organized orthopaedic rehabilitation programme.

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