Cost of prostheses in patients with unilateral transtibial amputation for vascular disease

A population-based follow-up during 8 years of 112 patients

Ylva Hermodsson and Björn M Persson

We analyzed the cost of prostheses for patients amputated because of vascular disease. During 1 year, 112 patients were treated with a primary unilateral transtibial amputation in Malmöhus county, Sweden, which has 527,000 inhabitants. During the first 6 months after the amputation, 50% (56/112) of the patients had received a prosthesis. At 6 months, 49 patients (7 had died) were examined, 18 had poor and 31 had good prosthetic function. Within 1 year, 71 (63%) patients had been fitted with a prosthesis. During 8 years after the amputation, they received altogether 137 prostheses and 54 exchange sockets; 59% of the prostheses and 26% of the sockets were delivered during the first year. Each patient received a median of 1 prosthesis and 1 extra socket. During the 8-year period, the total cost of prostheses, sockets and maintenance for the 71 patients was USD 228,746, representing a median cost of USD 1,582 per patient. The total cost of maintenance of the prostheses during the same period was USD 37,959, representing 20% of the total cost of all the prostheses and sockets. There was no statistically significant difference in the costs between patients with good or poor function.

Department of Orthopaedics, Helsingborg Hospital, SE-251 87 Helsingborg, Sweden. Tel +46 42-102510. Fax -102450
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According to statistics from the Handicap Institute, Stockholm, Sweden, the annual cost per capita of orthopedic appliances such as limb prostheses and footwear is about USD 10; about 10% of the total costs of the orthopedic departments. In 1995, 2,684 primary major amputations of the lower limb were performed in Sweden (Swedish National Board of Health and Welfare 1998, Engholm, personal communication). If approximately half of them are fitted with a prosthesis, 1,300 new users are given a prosthesis every year.

In a study of a 1-year cohort of lower limb amputees for vascular disease, we have earlier presented the fraction of patients fitted with a prosthesis (Hermodsson et al. 1998) and the in-hospital costs (Eneroth et al. 1996), where about 2/3 of all amputations were performed at the unilateral transtibial level. In this study we analyzed the annual number and costs of prostheses (including components, material and fitting work) in the unilateral transtibial amputees in the above-mentioned cohort during an 8-year follow-up.

Subjects and methods

Malmöhus county, Sweden, with a total population of 527,000, had 5 hospitals at the end of 1987: the University Hospital in Lund, the Helsingborg County Hospital and 3 smaller municipal hospitals. A consecutive registration study analyzing all major amputations for lower limb ischemia (n 177) was conducted at these hospitals during the year 1987 (Eneroth and Persson 1992). From this study all 112 patients with a primary unilateral transtibial amputation were examined at 6 months and they were prospectively followed 8 years after the amputation concerning survival (Figure 1), final amputations, prosthetic fitting and cost of prostheses. The prosthetic function was reevaluated among the survivors 8 years postoperatively. The mean age of the 112 patients was 77 (44–95) years with 47% (53/112) being 80 years or older. Further details about subjects and methods have been presented (Hermodsson et al. 1998).

Final level of amputation in the 71 patients fitted with a prosthesis. 2 patients needed a new amputation at the through-knee level and 7 at the transfemoral level. 13 patients had the other leg amputated at the transtibial level, 3 at the through-knee and 4 at the transfemoral level. 20 of the 71 patients became bilateral amputees. In addition, 3 patients had a partial foot amputation of the other leg.

Prosthetic fitting. 6 months after the amputation 50% (56/112) of the patients had received a prosthesis. Of them, 7 died before 6 months. At 6 months

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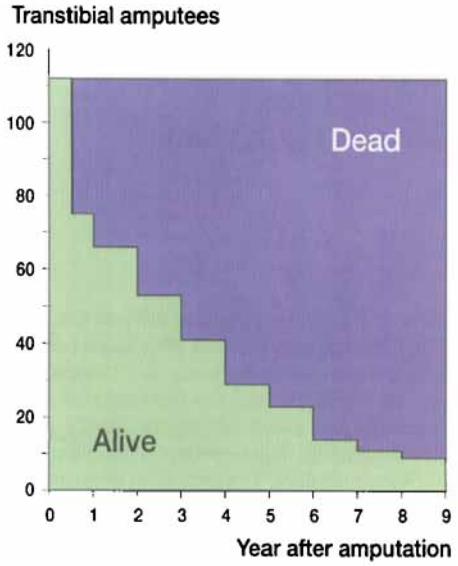

Figure. 1. Survival of 112 primary unilateral transtibial amputees during a period of 8 years postoperatively.

postoperatively, 49 patients were examined, 18 patients had poor and 31 had good function. Within 1 year, 63% (71/112) of the patients had been fitted with a prosthesis. 8 years after the amputation the fitting rate was still 63%.

Functional classification 6 months postoperatively. All 75 patients alive at follow-up after 6 months were examined by an orthopedic surgeon and a prosthetist and classified as follows:

1. No prosthesis.

2. Poor function with prosthesis. Patient does not wear it daily or wears it daily but cannot walk indoors without assistance, or is dependent on a wheelchair most of the time or all the time.

3. Good function with prosthesis. Patient wears it daily and can walk alone or with assistance outdoors or alone indoors.

Within 6 months postoperatively, 33% (37/112) of the patients had died. Among survivors, 49/75 were fitted with a prosthesis. 18 had poor function of whom 4 had had their leg reamputated at a higher level and one had had his other leg amputated at the transtibial level. 31 had good function. 1 of these had bilateral transtibial amputations.

Follow-up at 8 years. The mortality at 8 years was 92%, with 9 patients still alive. 3 patients had had their legs reamputated at a higher level. 2 of these had had the other leg amputated, 1 at the transtibial level and 1 at the transfemoral level. Yet another patient had bilateral transtibial amputations. All 9 patients were fitted with a prosthesis. 3 patients had the same prosthetic function 8 years after the amputation as they had had 6 months postoperatively, 1 had poor function, 2 had good function (Table 1).

Cost calculation

Information on costs and number of prostheses and sockets was provided by the 2 Orthopedic Workshops supplying the catchment area. If the other side had been amputated as well, the cost of fitting this side was included. All costs were calculated according to the price list from the workshops, accounting for the total costs of manufacturing the prostheses and sockets during the 8-year period. All costs are quoted in USD in 1997 prices; SEK 1 equalled USD 0.13. The mean RPI (Retailer Price Index) for 1987 up to 1995 was 5%.

Table 1. Sex, age, level of the first leg amputated and of the other leg together with function 6 months and 8 years postoperatively, total number of prostheses, sockets and total cost of prostheses (USD 1,000) of the amputees alive 8 years after the amputation (n 9)

	Patient no.								
Characteristics	1	2	3	4	5	6	7	8	9
Sex	female	female	male	male	male	male	male	male	male
Age at the end of the study	70	89	52	54	63	68	76	87	88
Side of amputation	left	right	left	right	left	right	right	right	right
6 months postoperatively									
Level of the first leg amputated	TFA	TTA	TTA	TTA	TTA	TTA	TTA	TTA	TTA
Level of the other leg	healthy	healthy	healthy	healthy	healthy	healthy	healthy	healthy	pregangren.
Function	poor	good	no pros.	poor	no pros.	good	good	good	no pros.
8 years postoperatively									
Level of the first leg amputated	TFA	TTA	TKA	TFA	TTA	TTA	TTA	TTA	TTA
Level of the other leg	healthy	healthy	TFA	TTA	healthy	healthy	BTA	BTA	TTA
Function	good	poor	poor	poor	good	good	good	poor	poor
Total number of prostheses	5	2	4	5	4	2	5	4	6
Total number of extra sockets	2	–	–	7	–	2	–	–	–
Total cost of prostheses (USD 1,000)	19	1	9	19	14	5	7	5	6

BTA big toe amputation, TFA transfemoral amputation, TTA transtibial amputation, TKA through-knee amputation

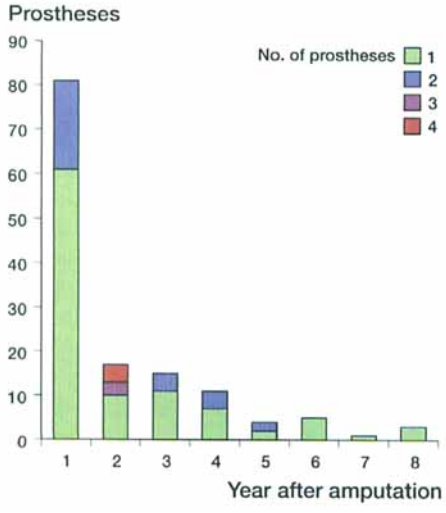

Figure 2. Annual number of prostheses for the 71 patients during an 8-year period postoperatively.

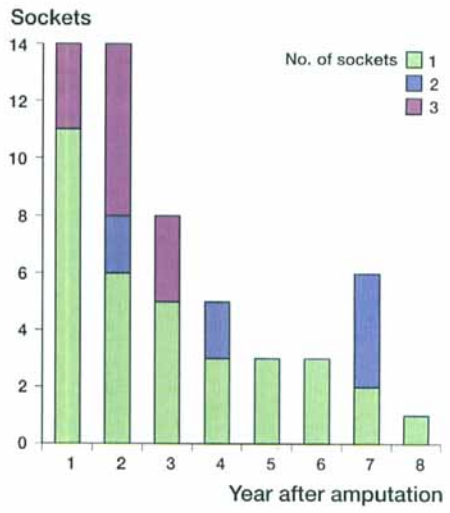

Figure 3. Annual number of sockets for the 71 patients during an 8-year period postoperatively.

Statistics

The Wilcoxon rank-sum test was used to investigate whether there was any difference in the total costs between the patients with good function and those with poor function at 6 months. The test was two-sided and had a significance level of 5%.

Results

Number of prostheses and sockets during 8 years postoperatively (Figures 2 and 3)

The 71 patients received 137 prostheses and 54 exchange sockets. 59% (81/137) of the prostheses and 26% (14/54) of the sockets were delivered the first year. The median number of prostheses was 1 (1–10). Additional sockets were manufactured for 24 patients. The median number of sockets was 1 (1–9).

Cost of prostheses for the 71 patients fitted with a prosthesis within 8 years postoperatively (Table 2)

99 prostheses for patients with a transtibial amputation were manufactured at a median cost of USD 898 (664–3,044), 2 for through-knee amputation at a median cost of USD 1,251 (1,208–1,294) and 13 for transfemoral amputation at a median cost of USD 2,409 (1,808–3,154). In addition, 47 sockets for transtibial amputees at a median cost of USD 733 (278–1,430) and 7 sockets for prostheses for through-knee and transfemoral amputees at a median cost of USD 1,202 (1,082–1,652) were delivered. 17 temporary prostheses at a median cost of USD 356 (250–522), 5 swimming prostheses at a median cost of USD 911 (837–1,882) and 1 prosthesis for a patient with a Chopart amputation (USD 518) were also made. The total cost of prostheses, sockets and maintenance was USD 228,746. The median cost per patient was USD 1,582 (250–1,876), which corresponds to a mean cost of USD 3,245 ± 3,992 per patient. The total cost of prostheses was USD 144,389 and for sockets USD 44,826. The total cost for maintenance of all the prostheses was USD 37,959, representing one fifth of the total cost of all the prostheses and sockets. Compared to the costs of prostheses, the costs of extra sockets alone represent one third of the costs of prostheses.

Cost and number of prostheses and sockets for the patients still surviving 8 years after the amputation

The 9 survivors had a total of 37 prostheses and 11 exchange sockets. The median number of prostheses was 4 (2–6). Additional sockets were made for 3 pa-

Table 2. Annual costs (USD 1,000) of prostheses, sockets and maintenance for the 71 patients during an 8-year period postoperatively

		Costs			
Year	n	Min	Median	Max	Total
1	71	0.25	1.0	3.4	87
2	28	0.017	1.0	6.0	36
3	22	0.059	1.1	4.7	33
4	16	0.065	1.3	5.0	26
5	13	0.11	1.0	5.0	16
6	10	0.12	1.3	2.8	14
7	5	0.076	1.1	3.6	7.2
8	3	2.6	3.0	3.3	9.0

Table 3. Annual total costs (USD 1,000) of prostheses, sockets and maintenance during an 8-year period postoperatively for the 49 patients classified as having poor function (n 18) and good function (n 31) at the functional classification 6 months after the amputation

Year	Function at 6 months	n	Cost			
			Min	Median	Max	Total
1	Poor	18	0.66	1.1	3.2	22
	Good	31	0.83	1.0	3.6	39
2	Poor	8	0.02	1.7	3.5	12
	Good	15	0.12	1.0	6.0	21
3	Poor	6	0.50	2.0	4.1	13
	Good	11	0.06	0.92	3.4	11
4	Poor	4	0.92	1.6	5.0	9.0
	Good	8	0.065	1.2	2.5	10
5	Poor	5	0.33	1.2	5.0	9.0
	Good	5	0.11	0.15	2.2	3.6
6	Poor	3	1.1	1.3	1.7	4.1
	Good	4	0.12	1.4	2.3	5.2
7	Poor	2	0.84	1.2	1.6	2.5
	Good	2	1.1	2.4	3.7	4.7
8	Poor	2	2.6	3.0	3.3	5.9
	Good	–	–	–	–	–

tients. The median number of sockets was 2 (2–7). The total cost of prostheses, sockets and maintenance was USD 84,913. The median cost was USD 7,312 (1,454–18,796). 2 patients had the highest cost of prosthesis and extra sockets, USD 19,000. One had good function and the other had poor, 8 years after the amputation (Table 2).

Difference in total cost of prostheses between patients with poor and good function (Table 3)

The total cost of prostheses for the 18 patients with poor function was USD 76,479, the median cost per patient was USD 1,114 (664–18,796). The total cost for the 31 patients with good function was USD 95,525, the median cost per patient was USD 2,072 (862–14,842). There was no statistically significant difference in the costs between patients with poor and good function.

Discussion

Our study is the first to report a longitudinal analysis of costs and number of prostheses and sockets among patients with unilateral transtibial amputation for vascular disease, in a defined population.

We have stated in an earlier study (Hermodsson et al. 1998) that two thirds of all the patients amputated were fitted with a prosthesis within 1 year, despite the high mortality rate of one third within 6 months postoperatively. Of the 71 patients accounted for in this study, half of the original 112 patients were 80 years or older and half of them had been fitted, while three fourths of those younger than 80 were fitted. Thus, when stating the fitting rate, the percentage of amputees who are 80 years or older must be specified.

As nine tenths of the patients had died after 8 years, one could argue that additional cost after 8 years would be of minimal importance. If the number of primary transtibial amputations did not vary, the same number of new amputations would be added every year. Thus the total costs for 8 years in a 1-year cohort of new amputees would about equal the total costs for each year, USD 229,000. This means that the annual cost per capita for the 527,000 inhabitants in Malmöhus county is USD 0.4.

Costs of prostheses vary from country to country, depending on whether they are provided for by public funds or by private means and insurance, whether there are any restrictions regarding choice of prosthesis, components and numbers over a certain period and whether the patients are seen on a regular basis at the orthopedic workshops. This applies to costs for operation and rehabilitation as well. In Sweden, the prosthesis is considered to be an aid for disabled persons and is paid for by the hospital. The amputations are performed by the orthopedic surgeons who also prescribe the prosthesis. The prosthetist manufactures the prosthesis and selects components according to the walking ability and needs of the patient (Hermodsson et al. 1994a, 1994b). The type is often discussed in the prosthetic team. In 1984, the limb-fitting cost in England was USD 877 (GBP 610) per fitted patient (Robertsson 1986). In 1985, the total cost of providing a final leg prosthesis, estimated by the rehabilitation department, was USD 6,400 in Los Ange-

les, California (Raviola et al. 1988). Without knowledge of the costs included and under what circumstances they have been calculated, comparisons are hard to make.

The mean cost of prostheses for 8 years for one patient in our study was USD 3,245. The mean cost of hospital stay and surgery in the study by Eneroth et al. (1996) was USD 54,000. Thus the cost of prostheses for a transtibial amputee having vascular disease corresponds on average to 6% of the costs for hospitalization and surgery.

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Eneroth M, Persson B M. Amputation for occlusive arterial disease. A prospective multicentre study of 177 amputees. Int Orthop 1992; 16: 383-7.

Eneroth M, Apelqvist J, Troëng T, Persson B M. Operations, total hospital stay and costs of critical leg ischemia. A population-based longitudinal outcome study of 321 patients. Acta Orthop Scand 1996; 67: 459-65.

Hermodsson Y, Ekdahl C, Persson B M, Roxendal G. Gait in male transtibial amputees: a comparative study with healthy subjects in relation to walking speed. Prosthet Orthot Int 1994a; 18: 68-77.

Hermodsson Y, Ekdahl C, Persson B M, Roxendal G. Standing balance in transtibial amputees following vascular disease or trauma: a comparative study with healthy subjects. Prosthet Orthot Int 1994b; 18: 150-8.

Hermodsson Y, Ekdahl C, Persson B M. Outcome after transtibial amputation for vascular disease. A follow-up after 8 years. Scand J Caring Sci 1998; 12: 73-80.

Raviola C A, Nichter L S, Baker J D, Busuttil R W, Machleder H I, Moore W S. Cost of treating advanced leg ischemia. Bypass graft vs. primary amputation. Arch Surg 1988; 123: 495-6.

Robertsson J C. Future of rehabilitation and artificial limb and appliance centre services in England: McColl report reviewed. Lancet 1986; (June 14): 1372-4.