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Upper limb prosthetic use in Slovenia

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Abstract

The article deals with the use of different types of upper limb prostheses in Slovenia.

Four hundred and fourteen upper limb amputees were sent a questionnaire on the type of their prosthesis, its use and reasons for non-use, respectively. The replies were subject to statistical analysis.

Most of the questioned upper limb amputees (70%) wear a prosthesis only for cosmesis. The use of a prosthesis depends on the level of upper limb amputation, loss of the dominant hand, and time from amputation. Prosthetic success appears to be unrelated to age at the time of amputation and the rehabilitation programme.

The most frequent reason for not wearing a prosthesis is heat and consequent sweating of the stump.

More than a third of amputees are dissatisfied with their prostheses.

Introduction

Even though upper limb prostheses were known already in ancient Egypt, they have never succeeded to completely substitute the three functions of the human hand – motor, sensibility and expressive functions. As an extension of the stump, a prosthesis should improve, not impede, its function. It should be even the best prosthesis is only a poor substitute.

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used in the way the non-dominant hand is normally used (Hermansson, 1991). However,

As reported by various authors, an upper limb amputee accepts and uses the prosthesis if it is comfortable, functional and has a pleasing appearance. Acceptance and successful use also depend on the quality of the stump, amputation level, level of education and employment status of the user, time from amputation to fitting a first prosthesis, use of a temporary prosthesis, training in use, and patient's motivation (Millstein *et al.*, 1986; Roeschlein and Domholdt 1989). Opinions on the importance of manual dexterity and loss of the dominant hand, respectively, differ considerably. Patients of the same age and with the same amputation level, who after completed rehabilitation and training achieved the same degree of independence, may use the prosthesis throughout the whole day or be reluctant to wear it.

According to different reports, upper limb prosthesis are used with different levels of success (Fletcher, 1970; Herberts *et al.*, 1980; Stein and Walley, 1983; Heger *et al.*, 1985; Vitali *et al.*, 1986; Stürup *et al.*, 1988; Roeschlein and Dumholdt, 1989).

According to Atkins (1989), a high rejection rate of upper limb prostheses can be attributed to development of one-handedness, insufficient training in use, poor comfort, poor construction, and the reactions of other people.

Purpose

The objective of this study is to determine the use and reasons for non-use of different types of upper limb prosthesis in Slovenia. The study also considered how amputees and their environment react to their prostheses.

Methods of work

The dispensary files of all persons who visited the Orthotic and Prosthetic Outpatient clinic at the University Rehabilitation Institute Ljubljana between 1 January, 1988 and 31 December, 1992 were surveyed. Upper limb amputees with a permanent residence in Slovenia were selected. They were sent a questionnaire on the extent to which they actually used their prostheses.

The responses were statistically analysed by the SPSS program *(Statistical Package for Social Sciences)*. Data were analysed by frequency distribution, Chi-square test, variance analysis test, and Student's t-test.

Respondents

In the last five years (1 January, 1988–31 December, 1992), 414 upper limb amputees were examined in the Prosthetic and Orthotic Outpatient clinic of the University Rehabilitation Institute Ljubljana. Some came for an examination only once, whereas others came several times.

Some 295 responses (71.3%) were received. Of these, 266 (90.2%, representing 64.3% of the questionnaires sent) were filled in, and 29 were left blank (deceased, unknown, departed, etc.). Not everybody answered all questions. All the questions which were answered in these 266 responses were analysed.

At the time of amputation, the persons concerned were fairly young, aged 20.0 years on the average (SD 14.1 years). As many as 238 (of the 266 responses) or 89.5% of the amputations resulted from accidents (127 or 47.7% were war injuries).

More than half (163 or 61.3% of 266) had trans-radial amputations, 54 or 20.3% had trans-humeral amputations and 34 (12.8%) had partial hand amputations; disarticulations in joints were rare (3 or 1.1% had disarticulation at the shoulder, 2 or 0.8% at the elbow, and 10 or 3.7% at the wrist.

Some 245 persons answered the question about handedness before amputation, 132 (53.9%) lost the dominant hand, 85 (34.7%) the non-dominant hand. Twenty-three (9.4%) had a congenital deficiency of the upper limb and in 5 (2%) bilateral amputation had been performed at the same level.

Results and discussion

The response rate to the questionnaire was within normal values.

As many as 63.5% (169) of responding upper

Table 1: Use of cosmetic and functional prostheses in daily work and statistically significant differences (p) obtained by Chi-square test.

Prosthetic use	Type of prosthesis				Total		
	Cosmetic		Functional				
	no	yes	no	yes	no	yes	p
Getting dressed	96	43	55	44	151 63.4%	87 36.6%	**
Personal hygiene	114	25	71	28	185 77.7%	53 22.3%	*
Eating	108	31	67	32	175 73.5%	63 26.5%	
Housekeeping	94	44	55	36	149 65.1%	80 34.9%	
Job	43	52	26	36	69 43.9%	88 56.1%	
Smaller domestic repairs	87	52	36	62	123 51.9%	114 48.1%	****
Peasant labour	99	26	52	44	151 68.3%	70 31.7%	****
Car driving	62	43	35	50	97 51.1%	93 48.9%	**
Recreation	95	33	65	26	160 73.1%	59 26.9%	
In social setting	33	106	23	76	56 23.5%	182 76.5%	

*p<0.1, **p<0.05, ****p<0.001

Table 2: Influence of time since amputation to the first prosthetic fitting prosthetic use – statistical significance p = 0.5.

Prosthetic use (hrs/day)	First prosthetic fitting					
	< = 1 year		> 1 year		Total	
	no	%	no	%	no	%
1-6	11	21.6	14	28.0	25	24.8
7-12	19	37.3	8	16.0	27	26.7
> = 13	21	41.2	28	56.0	49	48.5
Total	51	50.5	50	49.5	101	100.0

limb amputees in Slovenia had a cosmetic prosthesis and no less than 69.5% (185) possess one single prosthesis. Considering body-powered prostheses, twice as many individuals had a prosthesis with a hand compared to those with a hook. Only 6 patients were provided with a myoelectric prosthesis.

Prosthetic use

In Slovenia, upper limb amputees wear a cosmetic prosthesis for about 10.2 hours and a functional (body powered or myoelectric) prosthesis for about 11.8 hours a day (no significant difference). This is a greater usage than reported by Millstein *et al.* (1986), according to whom amputees use a prosthesis with a cable operated hook about 8 hours a day, one with a cable operated hand 5 hours a day and a cosmetic prostheses 4 hours a day. However, what that author had in mind was use, whereas in this study the question was of wearing. Upper limb amputees in Slovenia make more extensive use of functional prostheses at housekeeping and farm work ($p<0.001$), at getting dressed and driving a car ($p<0.5$), and in personal hygiene ($p<0.1$) (Table 1). In other activities, prosthetic use is unaffected by the type of prosthesis.

The number of hours per day and the type of occupation in which a person uses a prosthesis depend on the following:

1. time from amputation to the first fitting of the prosthesis (Table 2)
2. amputation level (Tables 3 and 4)
3. age at amputation (Table 5)
4. present age (Table 6)
5. loss of the dominant hand (Table 7).

The time of daily prosthetic use is not related to:

1. the type of prosthesis
2. the evaluation of the rehabilitation programme.

Time from amputation to the first fitting of the prosthesis

The relation between the time after the amputation and the number of hours of prosthetic use per day is completely non-linear (it was established neither by correlation coefficient nor variance analysis test, but only by (Chi-square test). A most relevant point to be considered is whether the patient got his first prosthesis during the first year after the amputation or not (Table 2).

The answers also displayed that at work, all prostheses are more readily used by persons who got them soon after amputation ($p<0.1$), while in a social setting they are more readily used by those who got them later ($p<0.1$). Persons, provided with a functional prosthesis soon after the amputation, more often use it in attending to housekeeping ($p<0.1$), at work ($p<0.01$), and performing simple repairs at home and at peasant labour ($p<0.05$).

These findings correspond with the statements by Robinson *et al.* (1975), Jacobs and Brady (1975), and Bailey (1970) that one of the first reasons underlying unsuccessful prosthetic use is delayed post-surgical fitting in upper limb amputation. After the amputation, amputees quickly learn to compensate for their loss by using the other upper limb. This compensation is often so efficient that the patient finds the prosthesis encumbering and is reluctant to accept it.

Table 3: Amputees with partial hand amputation use their prostheses (all) significantly less than others.

Amputation level	Prosthetic use (hours/day)
Trans-humeral	10.5
Trans-radial	10.7
Partial hand	5.9
F value = 4.1	$p < 0.05$

Table 4: Influence of amputation level on prosthetic use and statistically significant differences (p) obtained by Chi-square test.

Prosthetic use	Amputation level						Total		
	T-H		T-R		hand				
	no	yes	no	yes	no	yes	no	yes	p
Getting dressed	41	13	96	72	24	2	161	87	****
							64.9%	53.1%	
Personal hygiene	51	3	120	48	24	2	195	53	****
							78.6%	21.4%	
Eating	49	5	114	54	22	4	185	63	***
							74.6%	25.4%	
Housekeeping	43	9	96	65	20	6	159	80	***
							66.5%	33.5%	
Job	13	19	50	64	16	5	79	88	**
							47.3%	52.7%	
Smaller domestic repairs	31	23	84	83	18	8	133	114	
							53.8%	46.2%	
Peasant labour	40	12	104	52	17	6	161	70	
							69.7%	30.3%	
Car driving	23	22	70	67	14	3	107	93	*
							53.5%	46.5%	
Recreation	47	5	103	49	20	5	170	59	***
							74.2%	25.8%	
In social setting	15	39	33	135	18	8	66	182	****
							26.6%	73.4%	

*p<0.1, **p<0.05, *** p<0.01, ****p<0.001

T-H-trans-humeral, T-R-trans-radial amputation.

Amputation level

Persons with a partial amputation of the hand wear the prosthesis the lowest number of hours, while there is no difference in daily wearing of prosthesis between trans-radial and trans-humeral amputees (p<0.05) (Table 3).

The level of amputation does not affect prosthetic use at work, in performing simpler home repairs and in peasant labour (Table 4). These occupations seem to be of greatest importance to those persons who are most keen to attend to them. In all other activities, persons with a trans-radial amputation wear their prosthesis more than others. The reason may be that the prostheses hampered others, which many put down as a remark or stated as a reason for their non-use. This corresponds with the conclusions by Millstein *et al.* (1986) that trans-radial amputees alone use functional prostheses in daily activities, whereas the others find prostheses useless in attending to daily activities. As reported by Stürup *et al.* (1988), higher level amputees do not use body powered prostheses, while Roeschlein and Domholdt (1989) claims that the loss of the elbow is of no consequence to successful prosthetic use.

Age at amputation

Functional prostheses are used for slightly longer periods of time by persons who were young at the time of amputation (r = 0.26, p<0.05), and cosmetic prostheses by persons now older (r = 0.30, p=0.001).

Persons using the prosthesis in getting dressed and eating (p<0.05) and in a social setting (p<0.01) were at amputation

Table 5: Influence of age at amputation on prosthetic use obtained by variance analysis test and F values.

Function	Use	Age at amputation (years)	F value and p
Getting dressed	yes	17.7	
	no	21.0	3.04**
Eating	yes	17.0	
	no	20.8	3.4**
Social setting	yes	18.3	
	no	24.1	8.16***

**p<0.05, ***p<0.01

Table 6: Influence of present age on prosthetic use obtained by variance analysis test and F values.

Function	Use	Present age (years)	F value and p
Job	yes	45.0	
	no	50.4	4.74**
Peasant	yes	54.8	
	no	51.2	2.75***

**p<0.05, ***p<0.01

characteristically younger than those who do not use their prosthesis in the above-mentioned activities (Table 5). As for attending to other tasks, no significant differences in age at the time of amputation were observed with regard to successful or unsuccessful prosthetic use.

Present age

The current age of amputees has even less influence upon prosthetic use. It is worth noting that persons using a prosthesis at work are now a little younger (p<0.05) than persons who do not, while those using it at peasant work are slightly older (Table 6).

Loss of dominant hand

All prostheses (p<0.05), particularly functional (p<0.01), are worn mostly by amputees who have lost the non-dominant hand and least by bilateral upper limb amputees. The loss of the dominant hand is not significantly related to the time of wearing cosmetic prostheses.

The loss of the dominant hand has the most significant impact upon the use of the prosthesis at eating, work, and recreation, where the prosthesis is most used by bilateral and congenital amputees and more often by non-dominant than dominant hand amputees (Table 7).

The above conclusions are contrary to those drawn by Stürup *et al.* (1988), according to whom a prosthesis is more widely used by persons who sustained the loss of the dominant hand. Likewise, they do not agree with the statement by Roeschlein and Domholdt (1989) that the loss of the dominant hand exerts no influence upon successful use of a body powered prosthesis.

Most of the respondents failed to indicate at which occupations and recreational activities,

Table 7: Influence of loss of dominant hand on prosthetic use and statistically significant differences (p) obtained by Chi-square test.

Prosthetic use	Amputated side						Total		
	Dominant		Non-dominant		Both/congen.				
	no	yes	no	yes	no	yes	no	yes	p
Getting dressed	84	40	45	34	16	9	145	83	
							63.6%	36.4%	
Personal hygiene	102	22	59	20	18	7	179	49	
							78.5%	21.5%	
Eating	105	19	51	28	13	12	169	59	****
							74.1%	25.9%	
Housekeeping	84	37	50	25	12	11	146	73	
							66.7%	33.3%	
Job	45	35	20	35	7	12	72	82	**
							46.8%	53.2%	
Smaller domestic repairs	69	55	40	39	10	14	119	108	
							52.4%	47.6%	
Peasant labour	87	33	47	28	12	4	146	65	
							69.2%	30.8%	
Car driving	56	49	31	33	10	2	97	84	
							53.6%	46.4%	
Recreation	90	25	51	19	13	12	154	56	**
							73.3%	26.7%	
In social setting	39	85	13	66	6	19	58	170	*
							25.4%	74.6%	

*p<0.1, **p<0.05, ****p<0.001

Table 8: Reasons for non-use of cosmetic and functional prostheses; statistically significant differences (p), obtained by Chi-square test.

Reasons for non-use	Type of prosthesis				Total		p
	Cosmetic		Functional				
	no	yes	no	yes	no	yes	
Damage possibility	120	22	86	15	206 84.8%	37 15.2%	
Weight	120	22	84	17	204 84.0%	39 16.0%	
Heat, sweating	81	61	51	50	132 54.3%	111 45.7%	***
Loss of sensation	113	29	88	13	201 82.7%	42 17.3%	*
Mood	116	26	88	13	204 84.0%	0 16.0%	
Other	104	38	81	20	185 76.1%	58 23.9%	

*p<0.1, ***p<0.01

respectively, they used the prosthesis. Those who answered the question stated that they habitually made extensive use of functional prostheses for peasant work. More than a third of them use functional prostheses for all sorts of peasant labour. In recreational activities, preference is given to the use, or rather, wearing of cosmetic prostheses. From the point of view of different branches of sport (walking, jogging, cycling, skiing, football, gymnastics, bowling), prostheses are mostly irrelevant to function. The respondents most frequently used both types of prostheses at cycling. Sports such as referred to by Millstein *et al.* (1986) differ from those favoured in other countries where certain branches of sport enjoy greater popularity than others.

The type of prosthesis

The fact that the type of prosthesis is not related to successful prosthetic use proves that in answering the question the respondents were not really referring to the number of hours per day during which they used the prosthesis but rather to how long they wore it. Thus, there seems no point in dividing persons into active, i.e. successful prosthetic users, and partially active and passive users, as proposed by Kejlaa (1992) and Roeschlein and Domholdt (1989).

Table 9: Influence of amputation level on reasons for non-use of prostheses and significant differences (p), obtained by Chi-square test.

Reasons for non-use	Amputated level						Total		p
	T-H		T-R		hand				
	no	yes	no	yes	no	yes	no	yes	
Damage possibility	48	9	144	26	24	2	216 85.4%	37 14.6%	
Weight	44	13	145	25	23	3	212 83.8%	41 16.2%	
Heat, sweating	22	35	101	69	19	7	142 56.1%	111 43.9%	***
Loss of sensation	51	6	139	31	18	8	208 82.2%	45 17.8	*
Mood	45	12	147	23	22	4	214 84.6%	39 15.4%	
Other	45	12	128	42	22	4	195 77.1%	58 22.9%	

*p<0.1, ***p<0.01
T-H-trans-humeral, T-R-trans-radial.

Table 10: Influence of present age on non-use of the prosthesis due to heat and sweating obtained by variance analysis test.

	Present age (years)
use	47.4
non-use	53.9
	F value = 10.15 p < 0.01

Table 11: Influence of age at amputation on non-use due to weight of the prosthesis obtained by variance analysis test.

	Age at amputation (years)
use	18.7
non-use	25.3
	F value = 7.65 p < 0.01

Evaluation of the rehabilitation programme

The number of hours of prosthetic use does not depend on the evaluation of the rehabilitation programme (either for all prostheses together or separately by types of prostheses). No interconnection was established either by the variance analysis test or Chi-square test. This means that there is no interconnection between the rehabilitation programme that the persons were subject to and the number of hours during which they use prostheses.

What stops amputees from using a prosthesis

Table 8 refers to reasons that stop amputees from using a prosthesis, displayed separately for different types of prosthesis. The most frequent reasons are heat and sweating, and only in the third place (17.3%) the loss of sensation, even though McDonnell *et al.* (1989) state that the prosthesis weakens the amputee's sense of position in space.

The most frequent reasons to stop using a functional prosthesis are heat and sweating, and the loss of sensation. These two reasons are characteristically affected by the level of amputation (Table 9). Heat and sweating are most disturbing to persons with Trans-humeral amputation ($p<0.01$), and the loss of sensation to persons with a partial hand amputation ($p<0.1$).

The amputees, who stop using the prosthesis because of heat and sweating, are now younger ($p<0.01$) than the others, while other reasons for unsuccessful use are unrelated to age (Table 10).

Age at amputation has a significant influence only upon prosthetic non-use due to the weight of the prosthesis. The persons identifying the weight of the prosthesis as a reason for not using it, were significantly older at the time of amputation ($p<0.01$) (Table 11).

The persons who resist using the prosthesis due to loss of sensation, were fitted with their first prosthesis later after the amputation

Type of prosthesis	Reactions in social milieu						Total	
	Negative		Medium		Positive			
	No.	%	No.	%	No.	%	No.	%
Cosmetic	16	12.6	9	7.1	102	80.3	127	58.0
Functional	16	17.4	9	9.8	67	72.8	92	42.0
Total	32	14.6	18	8.2	169	77.2	219	100.0

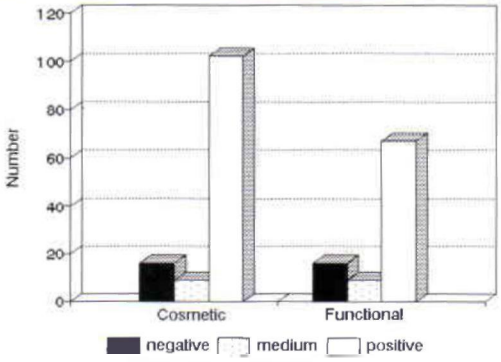

Fig. 1. Reactions in amputees' social milieu.

($p<0.05$) than those who did not identify this reason. The time lapse from amputation to the first prosthetic fitting had no significant effect upon the other reasons for non-use.

Acceptance of the prosthesis by the amputee's social milieu

Healthy people in Slovenia react to different types of prostheses in much the same way (Fig. 1). This may result from the fact that among functional prostheses there are twice as many prostheses with a hand as a hook, so they do not differ greatly in appearance from cosmetic prostheses, A high percentage (169 or 77.2%) of the respondents report positive reactions from the population at large to the prosthesis. This percentage is much higher than the percentage of the amputee's expectations (126 or 53.8%).

Fulfilment of the amputee's expectations

It is interesting to note that no significant differences exist in the fulfilment of the amputee's expectations between cosmetic and functional prostheses (Fig. 2). A surprisingly high percentage of cosmetic prostheses have met expectations, from which it may be concluded that a large number of amputees are very sensitive about their cosmetic appearance. This is confirmed by the high percentage of cosmetic prostheses which are provided in Slovenia and by functional prostheses for the hand being fitted twice as often as the hook.

Table 12: The fulfilment of the amputee's expectations is significantly related to the number of hours per day during which they use a functional or cosmetic prosthesis (variance analysis test).

Satisfied with prosthesis	Use (hrs/day)	
	Cosmetic	Functional
Yes	11.9	14.1
Medium	4.9	9.8
No	7.2	8.0
	F value = 12.0 $p < 0.001$	F value = 8.1 $p < 0.001$

The fulfilment of expectations is not affected by the time lapse since amputation to the first fitting of a cosmetic or functional prosthesis.

The fulfilment of the amputee's expectations is significantly related to the number of hours per day during which they use a functional prosthesis ($p<0.001$) (Table 12). The persons stating that the functional prosthesis has met their expectations use it longest during the day, whereas those disappointed with the prosthesis use it the least hours in a day.

Cosmetic prostheses are worn most by persons according to whom the prosthesis has met their expectations to a limited extent. They are worn least by persons with whom the prostheses has failed to fulfil any of their expectations (Table 13).

Type of prosthesis	Fulfilment of the amputee's expectations						Total	
	yes		partially		no			
	No.	%	No.	%	No.	%	No.	%
Cosmetic	67	46.5	15	10.4	53	36.8	144	57.7
Functional	59	58.4	12	11.9	28	27.7	101	42.3
Total	126	53.8	27	11.5	81	34.6	234	100.0

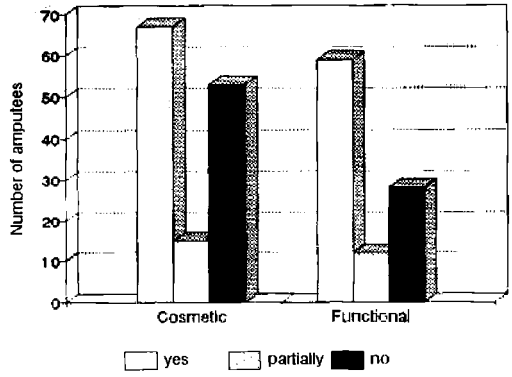

Fig. 2: Type of prosthesis does not influence significantly the amputees' expectations (Chi-square test).

The fulfilment of the amputee's expectations is not significantly related to either the age at amputation or the current age.

The majority of persons with a cosmetic prosthesis stated that it had not met their expectations as it was merely cosmetic and unsuitable for work. Secondly the view was expressed that it is aesthetically deficient. The fact that the prosthesis is not applicable at work, being more of an encumbrance than aid, is another reason for non-use.

Surprisingly enough, a third of the respondents were of the opinion that a functional prosthesis, too, is just a cosmetic aid. The reason underlying this belief may be that these amputees were not included in a suitable rehabilitation programme. Another third of the respondents, fitted with a functional prosthesis, stated that the prostheses were poorly made, not strong enough, and unreliable. These are further reasons for unsuccessful prosthetic use.

Conclusion

In the last few years, an obvious improvement in the general attitude to prosthetic use can be observed in Slovenia, though the use of upper limb prostheses is far from satisfactory.

In Slovenia, the use of upper limb prostheses is related to factors which are not under human control (level of amputation, loss of the dominant hand, age at amputation) and also factors that can and must be controlled. Two most outstanding of these are:

1. time from amputation to the first prosthetic fitting
2. type of prosthesis.

Another area open to external control is a suitable rehabilitation programme. Its influence upon the use of functional prostheses however has not been confirmed by this study.

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