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A clinical evaluation of stumps in lower limb amputees

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Abstract

A study was carried out on 93 consecutive unilateral below-knee (BK) and 62 above-knee (AK) amputees. The dimensions of the amputation stumps were measured and the general condition and contralateral limb assessed at the time of prosthetic fitting. After one postoperative year, follow-up information for 124 (89%) of the surviving patients was obtained by personal contact. The observations were based on the standard formula for stump classification constructed by the International Society for Prosthetics and Orthotics.

The 93 BK stumps had a mean length of 16.0 cm and the 62 AK stumps a mean length of 28.0 cm. The scar on the stump was adherent in 13% of BK and 2% of AK stumps. The scar was deeply wrinkled in 7% of BK stumps and 10% of AK stumps. The scar on the stump was most frequently adherent or deeply wrinkled in trauma patients (33%). The skin was undamaged in 93% of all the patients at the first visit and in 94% at the time of follow-up. The mobility of the stump in the proximal joint was limited at the time of prosthetic fitting in 15% of cases. Phantom pain was reported by 59% and stump pain by 5% of patients at this time. Although the phantom pain was mild in most cases, it was usually still present after one year, and 53% of the surviving patients suffered from phantom pain. At the first visit, 20% of patients had problems in their contralateral leg. During the first postoperative year, 6 contralateral BK amputations were performed in the BK group and one contralateral AK amputation in the AK group. Thus, along with examination of the stump, attention must be paid to the contralateral limb with a view to preserving it. The study supports the usefulness of the standard form and classification of amputation stumps.

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Introduction

A systematic examination of the stumps following major amputation allows certain important characteristics to be identified, improving the chances of detecting problems and correcting malfunctions (Persson and Liedberg, 1983). The increasing number of amputations among elderly patients with occlusive arterial disease increases the need for an objective evaluation of stumps, since old patients are often not well-informed themselves (Persson and Liedberg, 1983). Many different systems of stump classification have been developed but none has achieved universal acceptance. The main reason for this may be that clinical teams in different countries have different patients, and technical problems and possibilities for treatment. They therefore develop their own descriptive categories to meet their individual needs (Wall, 1988). International systems need to be comparable if measurements are to be related to each other. The basic parameters and standard form of a classification system were accepted at the Third World Congress of the International Society for Prosthetics and Orthotics (ISPO) in Bologna, October 1980 (Persson and Liedberg, 1983).

The basic parameters of classification for stumps will include the following (Persson and Liedberg, 1983; Wall, 1988):

1. stump dimensions;
2. stump shape;
3. the scar on the stump;
4. the condition of the skin on the stump;
5. the firmness of the stump;

6. the condition of the end of the stump;
7. mobility of the stump on the proximal joint;
8. pain;
9. certain features of the contralateral leg.

This paper applies the basic parameters and a modified version of the standard form to the stumps of a series of Finnish lower limb amputees.

Materials and methods

The patient sample consisted of a total of 155 consecutive patients, sent by the operative units to the Prosthetic Factory of Helsinki for prosthetic fitting. Seventy-two per cent (112) of the patients were males and 28% (43) females. A total of 93 patients (60%) had undergone below-knee (BK) amputation and 62 patients (40%) above-knee (AK) amputation. The mean age of the patients was 62.8 years (range 14–87 years). The mean age was 73.0 for female BK and 62.8 years for female AK amputees. The corresponding figures for the men were 59.9 and 61.7 years. The majority of the patients, 107 (69%), were in the 60–79 years age group.

The reasons for amputation were vascular disease in 126 cases, trauma in 15 cases, tumour in 10 cases, frostbite in 3 cases and infection in one patient.

The amputations were mainly carried out in hospitals in Southern Finland. All the operations were performed between November 1985 and August 1988. Vacuum drainage of the wound was used to avoid the formation of a haematoma. All the stumps were kept in soft dressings to protect the wound and to apply pressure. The delay between the operation and the first permanent prosthesis was 16 weeks in BK amputees and 16.3 weeks in AK amputees. During the first visit, the patients were examined and interviewed and measurements made by the author and a certified prosthetist. The author also evaluated the medical records of the patients which were made by the operative units.

Out of the complete sample of 155 patients, 16 (10%) died during the first postoperative year. Follow-up information for 124 (89%) of the surviving patients was obtained by personal contact after one postoperative year, with patients being interviewed and examined by the author. Of the 124 follow-up patients, 78 were BK and 46 AK amputees.

The length of the stump was measured from the distal end of the stump to the medial joint space of the knee in BK stumps, and from the end of the stump to the crotch in AK stumps. The healing phase of the wound was recorded at the same time. The examinations were intended to describe size, shape and atrophy, allowing classification of stumps into cylindrical, conical or club-shaped.

Partial correlation coefficients were used to evaluate the relationship between stump variables and the walking functions.

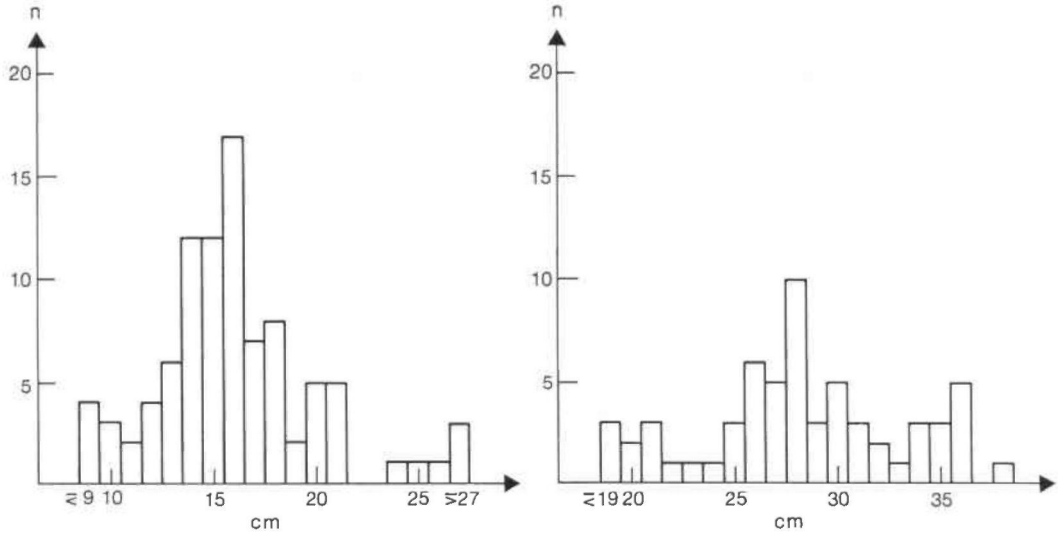

Figure 1. Left, length of below-knee stumps. Right, length of above-knee stumps.

Table 1. Shape of below and above-knee stumps at the time of prosthetic fitting and after one postoperative year.

Stump shape	Amputation level BK	%	AK	%
First visit				
Conical	39	42	36	58
Cylindrical	51	55	25	40
Club-shaped	3	3	1	2
Follow-up				
Conical	51	65	29	63
Cylindrical	27	35	17	37
Club-shaped	0	0	0	0

Results

The following results are presented in the order (1–9) of the standard form of ISPO (Persson and Liedberg, 1983).

The 93 BK stumps had a mean length of 16.0 cm, range 5–36 cm (Fig. 1, Left) and the 62 AK stumps a mean length of 28.0 cm, range 10–38 cm (Fig. 1, Right).

The shapes of the BK and AK stumps at the time of first visit and after the first postoperative year are presented in Table 1. At the first visit the shape was cylindrical in 49%, conical in 48%, and club-shaped in 3%. BK stumps became more conical during the first postoperative year and about two-thirds of BK and AK stumps were conical at the time of review.

The scar on the stump was adherent in 12/93 patients (13%) in the BK group and in 1/62 patients (2%) in the AK group. The proportions were the same after one postoperative year. The scar was deeply wrinkled in 7% of BK stumps and in 10% of AK stumps. The scar on the stump was adherent or deeply wrinkled in 5/15 trauma patients (33%).

The skin was undamaged in 93% of all the patients at the first visit and in 94% at the time of follow-up, with little difference between AK and BK levels (Table 2). At the time of prosthetic fitting, the skin of the stump was intact in 98% of all the 49 arteriosclerotics, in 90% of the 76 diabetics, in 90% of the 10 tumour patients and in 94% of the 15 trauma patients.

Table 2. Skin condition among above and below-knee stumps.

Condition	First visit BK	%	AK	%	Follow-up BK	%	AK	%
Undamaged	83	89	61	98	71	91	45	98
Abrasion	5	6	0	0	3	4	0	0
Ulcer	1	1	1	2	4	5	1	2
Scab	4	4	0	0	0	0	0	0
Total	93	100	62	100	78	100	46	100

After the first postoperative year the skin of the stump was normal in all the tumour patients, in 93% of the arteriosclerotics, in 96% of the diabetics and in 80% of the trauma patients. The most common skin lesion in the stump of the trauma patients was abrasion.

The BK stumps were soft in 30 cases (32%) and the AK stumps in 17 (28%) at the time of the first visit. At the time of follow-up, there were 5 (7%) soft BK stumps and 3 (6%) AK stumps.

Among the BK stumps the end of the stump was rounded and well protected in 81 (87%) of cases, slightly pointed in 9 (10%) and clearly pointed and poorly protected in 3 (3%). The corresponding figures for the AK stumps were 53 (85%), 8 (13%) and 1 (2%), respectively.

The mobility of the stump in the proximal joint was limited at the time of prosthetic fitting in 26 patients (15%), of whom 14 were AK and 12 BK amputees. The limitation of hip extension in AK amputees was mild (0 degrees of limitation) in 12 cases and moderate (0–12°) in 2 cases. The limitation of the knee joint in BK amputees was mild (5–10°) in 10 patients and moderate (10–20°) in 2 patients.

After the amputation phantom pain was a problem in 91 patients (59%), phantom limb in 64 (41%) and stump pain in 7 (5%) (Table 3). At the time of the review the corresponding figures were 66 (53%), 22 (18%) and 7 (6%). The severity of the stump symptoms is presented in Table 4. In one patient the stump pain was severe enough to limit walking. After amputation, 4% of patients experienced phantom pain coexisting with stump pain, while 30% experienced phantom pain with phantom

Table 3. Phantom limb, phantom pain and stump pain among BK amputees and AK amputees.

Symptoms	BK	%	AK	%
At the time of prosthetic fitting				
Phantom pain	53	57	38	61
Phantom limb	43	46	21	34
Stump pain	3	3	4	6
After one postoperative year				
Phantom pain	39	50	27	59
Phantom limb	16	21	8	17
Stump pain	6	8	1	2

Table 4. Severity of stump symptoms.

Stump symptom	At the time of prosthetic fitting n	%	After one post-operative year n	%
Phantom pain				
Mild (1)	66	73	46	70
Moderate (2)	25	27	20	30
Severe (3)	—	—	—	—
Phantom limb				
mild (4)	54	84	19	86
moderate (5)	10	16	3	14
severe (6)	—	—	—	—
Stump pain				
mild (1)	5	72	4	57
moderate (2)	1	14	3	43
severe (3)	1	14	—	—

1) Infrequent, mild pain, not requiring analgesics.
2) Fairly frequent pain, occasionally requiring analgesics.
3) Regular pain affecting the daily life of the amputee, requiring regular analgesics.
4) Infrequent sensation of lost limb.
5) A fairly frequent phenomenon causing occasional disturbance.
6) A regular phantom phenomenon causing regular disturbance.

limb. The corresponding figures at the end of the first postoperative year were 4% and 19%. Phantom pain and stump pain had a relationship with reduced walking distance ($p<0.05$) and reduced outdoor walking ($p<0.05$).

At the first visit, tenderness of the stump on palpation was found in 9 (10%) BK and in 8 (13%) AK stumps. The corresponding figures at the time of review were 6 (8%) and 4 (9%).

The state of the contralateral limb at the time of the first visit and after the first postoperative year is presented in Table 5. Of the 155 amputees, 124 (80%) had no problems in their contralateral leg at the time of the first visit. The most common pathological finding was a leg ulcer. During the first postoperative year, 6 contralateral BK amputations were performed among the 78 BK amputees and one contralateral AK amputation among the 46 AK amputees. After the first postoperative year, 110 (89%) of patients had no problem in their contralateral leg.

In the group of 124 follow-up patients, 42 (34%) suffered from ischaemic pain in the contralateral leg. The pain was mild in 19 amputees (15%), quite severe in 21 amputees (17%) and severe in 2 amputees (2%).

Table 5. Condition of the contralateral leg in below and above-knee amputees.

Condition	BK	%	AK	%
At the time of prosthetic fitting				
Normal	72	77	52	84
Ulcer	10	11	4	6
Oedematous	3	3	3	5
Eczema	2	2	2	3
Toe amputation	3	3	1	2
Foot amputation	3	3	—	—
After one postoperative year				
Normal	68	87	42	91
Ulcer	4	5	1	2
Oedematous	0	0	2	4
Toe amputation	1	1	—	—
Foot amputation	1	1	—	—
BK amputation	6	8	—	—
AK amputation	—	—	1	2

Discussion

There are relatively few publications on the general condition of amputation stumps. Many reports describe various problems of rehabilitation (Narang *et al.*, 1984; Steinberg *et al.*, 1985; Cumming *et al.*, 1987; Kullmann, 1987; Moore *et al.*, 1989) and pain in stumps (Steinbach *et al.*, 1982; Sherman and Sherman, 1983; Jensen *et al.*, 1985) but they do not deal with other parameters such as shape, firmness, strength, or range of motion.

There is no specific site of choice for BK amputation, but the lowest quarter of the leg is avoided, as the tibia and fibula are covered only by tendons and fascia in this area (Burgess, 1982). On measuring 58 BK stumps, Renström (1981) found a mean length of 14 cm. In another BK group, Persson and Liedberg (1983) reported a median length of 16 cm; the stump length was classified as normal in 81%, short in 13% and long in 6%. In the present study there was also a mean length of 16 cm for BK stumps. No allowance was made for shrinkage of the soft tissues by using circumferential measurements and the length-to-breadth proportion, as was done by Persson and Liedberg (1983), since the amputees came from other hospitals for examination, and prosthetic fitting took place as late as 16 weeks after amputation. In the BK material, 4 stumps were classified as short (<9 cm) and 6 as long (>24 cm) (Fig. 1). It is better to use proportional measures which take into account the diameter of the stump, and the new definition of long and short stumps employed

by Persson and Liedberg (1983), than absolute measures in centimetres or relative measures expressed as a percentage of the unamputated side. The stump measures require no special equipment and can be made by any member of the amputee team.

Gonzales *et al.* (1974) studied energy expenditure of unilateral BK amputees with various stump lengths. Patients with long stumps had a 10% average increase in energy expenditure above normal, whereas those with short stumps had a 40% average increase. Thus as great a length as possible should be saved, consistent with the pathology present.

The techniques for AK amputation may vary widely depending on the aetiology. In the dysvascular patient the surgeon must make every effort to avoid AK amputation, in favouring instead knee disarticulation or BK amputation in order to preserve the advantages of having end-bearing or of retention of the knee joint, with increased possibilities for locomotion and a return to the community (Burgess and Matsen, 1981; Stirnemann *et al.*, 1987; Neff, 1988). The length of the stump affects the alignment of the prosthesis. There are no reports in the literature concerning the optimal measures of AK stumps. In the present study the mean length of the AK stump was 28 cm.

The size, shape and degree of atrophy of the stump determine the type of suspension. In the BK group of Persson and Liedberg (1983) the shape was cylindrical in 80% of cases, conical in 19% and club-shaped in 1%. Corresponding figures of the present study were 49%, 48% and 3%. In this series, the time lag between surgery and the first visit was rather long (16.4 weeks) and the fairly general use of shrinker socks could reduce limb volume and mould stump tissues. In the case of the BK amputation it is important to record whether the fibula is prominent or the distal end of the tibia is pointed or not.

The position of the scar is irrelevant as long as plastic principles are practised and the scar is non-tender, non-adherent and pliable (Burgess, 1982) and the incision is healed. In the present series the scar on the stump was more frequently adherent to bone tissue in BK (13%) than in AK (2%) stumps.

Moreover, skin lesions were more common in BK amputees (Table 2). Five out of 15 trauma patients had skin adherent to the bone at the time of prosthetic fitting; 2 of them had abrasions and one patient had an ulcer in the stump at the time of review. Adherent scars were most commonly found in the trauma group and seem to be a risk factor for skin problems in stumps.

Francis and Renton (1987) reported a 7% incidence of flexion contracture of the knee joint after BK amputation. In the BK amputation group of the present study there were 12 (13%) knee flexion contractures of which 10 were mild (5–10 degrees) limitations. Moffat *et al.* (1981) suggested that useful mobility with a prosthesis is still possible if the contracture is under 15°. In the AK group of the present study 12 out of 14 hip contractures were also mild, and joint contractures did not disturb rehabilitation during the first postoperative year.

In the literature there are various reports on the prevalence of phantom pain. Renström (1981) reported an incidence of 18% for phantom pain among 63 BK amputees. In the series of Persson and Liedberg (1983), stump pain was a problem in 18% and phantom pain in 21% of BK amputees. Sherman and Sherman (1983) reported an over 80% prevalence of phantom pain among more than 11,000 amputee veterans. Other researchers (Carlen *et al.*, 1978; Steinbach *et al.*, 1982; Jensen *et al.*, 1985) have found similar rates of occurrence in other populations. A study of persons with amputations or disarticulations proximal to the ankle revealed that phantom limbs were experienced by 55% of a group of 93 lower limb amputees (Otsuka, 1987). In the present study, there was a 59% prevalence of phantom pain at the time of prosthetic fitting, which diminished only to 53% during the first postoperative year and phantom pain and stump pain had a significant association with walking functions. Pain is always difficult to describe and is largely incapable of measurement. It is important to make the differentiation between spontaneous pain and tenderness. Accordingly the presence or absence of spontaneous pain, tenderness, presence of any palpable neuroma, pain after exercise, presence or absence of phantom pain and similarly of pain in the proximal joint are to be recorded.

In this study, 7 of the follow-up patients (6%) required major amputation of the contralateral

limb during the follow-up year. All these patients were vascular patients. Other lesions of the contralateral limb were also fairly common. The end-stage nature of arteriosclerosis in these patients affects the entire arterial tree; similar end-stage disease is usually found in the contralateral limb and in other organs. This emphasises the need for systematic observation and a search for early lesions. Such patients must also be educated in avoiding injury to the contralateral limb and in reporting promptly any changes in symptoms in the contralateral limb. Prophylactic foot care should be encouraged and medical personnel should be taught to give attention to arteriosclerotic and diabetic feet.

There is a need for an objective evaluation and international classification of amputation stumps to compare one publication with another (Wall, 1988). The different clinic teams might use a standardised form of stump description and general acceptance of such a system would also be of interest to epidemiologists and government health officials (Wall, 1988). This study supports the usefulness of the ISPO standard form and classification of amputation stumps. However, many descriptions are determined in practice by inspection, palpation and questionnaire on pain. In order to make the system of stump classification more comparable it may be necessary to develop more definite scales for some elements in the description.

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