*Prosthetics and Orthotics International, 1983, 7, 9–14*

# Amputations for vascular insufficiency

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**Abstract**

A study was carried out of 302 major amputations for vascular insufficiency in the lower limb with respect to levels of amputation, postoperative revisions, re-amputations on a higher level and postoperative mortality. This information was related to vascular disease (diabetes mellitus/arteriosclerosis) and to the experience of the surgeon.

There was a high incidence of above-knee amputations both of diabetics and arteriosclerotics and the rate of complications was high for "senior" as well as "junior" surgeons. The amputations were performed during 1978 and the study has shown that there is an urgent need to lower the level of amputation without increasing the rate of complications. The study indicates that there is a need for further information about the problems involved in rehabilitation of above-knee amputees.

## Introduction

Amputation of a lower limb causes a handicap which in many cases makes the patient dependent on other people. The more proximal the amputation, the greater the risk that the patient will not regain his ability to walk at all (Wagner, 1978; Robinson, 1980). The majority of amputations performed in the Western world today are due to arterial insufficiency (Hansson, 1964; Burgess et al. 1971, Potts et al., 1979). The patients are elderly and their main disease—arteriosclerosis or diabetes mellitus—has caused changes in other organs besides the lower limbs, such as brain and heart disorders and in diabetics frequently eye and kidney disorders (Widmer et al. 1964).

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Walking with an above-knee (AK) prosthesis is much more energy-consuming than with a below-knee (BK) prosthesis (Waters et al. 1976). This means that many patients will never be capable of using their prosthesis after AK amputations (Romano and Burgess, 1971; Wagner, 1978). Furthermore even wheelchair or bedridden patients are much better off when the knee joint is preserved or through-knee (TK) amputation performed, than after an AK amputation (Hirsch et al. 1975; Hölter et al. 1980). The sitting patient achieves better balance with a longer stump and for the patient confined to bed it will be easier to shift his position (Persson, 1974).

Preoperative determination of the optimum level of amputation is difficult and still depends to a great extent on a clinical evaluation. A number of authors, however, have presented methods aiming at objective measurement of circulation and blood flow in the intended level of amputation (Carter, 1973; Holstein, 1973, Gibbons et al. 1979, Wagner, 1979a, Pollock and Ernst, 1980). Even though the general interest in amputation surgery has increased in recent years, the number of published articles in this field are still relatively few (Persson, 1980). Burgess et al. (1971) and Murdoch (1977) have recommended that the selection of amputation level and the operation itself always be performed by surgeons with long experience and adequate surgical skill. However, it is our impression that this recommendation is not always followed. The aim of the present study, therefore, was to analyse a large number of amputees, with particular reference to the level of amputation, the incidence of complications, and the experience of the surgeon.

## Material and methods

Through the kind co-operation of all surgical

and orthopaedic clinics in Stockholm, all patients who had a lower limb amputation in 1978 could be traced in 1980 with the aid of the computer centre of the Stockholm health care system. The material comprises all patients amputated due to arteriosclerosis or diabetes. All patient files have been studied and the material computerized.

Patients with a diagnosis of diabetes mellitus were, regardless of concomitant arteriosclerosis, registered as diabetics (Goldner, 1960). The surgeon was classified as "senior" if he had more than 5 years surgical experience, those with less were classified as "junior". Only major amputations (BK, TK and AK) are included in the statistical analyses as the figure for toe amputations is uncertain and the number of foot amputations were limited.

The population of Stockholm on December 31, 1978 was 1,519,114, comprising 735,458 men and 783,656 women. The age group above 50 years of age was 475,401, of which 207,208 were men.

In 1978, 308 major amputations were performed on 289 patients in 9 surgical and 5 orthopaedic departments in Stockholm. In four cases complete patient files were not available. These patients, as well as two patients with the diagnosis of Buerger's Disease (43 and 39 years old), were included in the above figures. The statistical figures presented are thus based on 302 amputations in 283 patients.

In some cases it was impossible to obtain complete data from the records. For this reason, a footnote is added to the appropriate Table stating the number of dropouts with respect to the analysed parameter.

The sex and age distribution is shown in Figure 1. The average ages for men and women with arteriosclerosis and diabetes are presented in Table 1 along with the number of patients, sex distribution and the number of amputations.

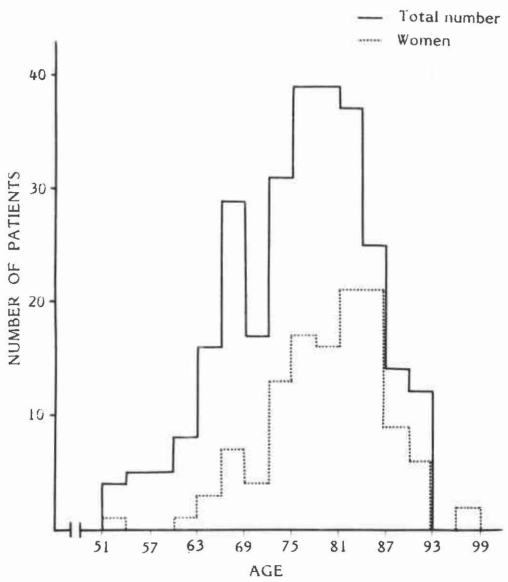


Fig. 1. Age and sex distribution of 283 patients with major amputations of the lower limb for arterial insufficiency during 1978 in Stockholm.

## Results

For each patient the first major amputation performed during 1978, revisions and more proximal amputations are presented in Table 2. The same table shows the postoperative mortality, defined as death occurring within one month of the major amputation.

Some 64 per cent of all amputations performed by "junior" surgeons were below-knee, while the corresponding figure for "senior" surgeons was 63 per cent. The frequency of re-amputations was higher for operations performed by "junior" surgeons as shown in Table 3.

Three different techniques for below-knee amputations were used:

1. The "Fishmouth" technique with approximately equal anterior and posterior skin flaps (Rob and Smith, 1969). The available

Table 1. Distribution of 283 amputees with respect to sex and diagnosis. Mean age ± 1 SD (years) has been stated for each group of patients. The total number of amputations is also shown.

| | MEN | | WOMEN | | TOTAL | | Number of amputations |
|---|---|---|---|---|---|---|---|
| | No. | Mean age | No. | Mean age | No. | Mean age | |
| Diabetes mellitus | 65 | 70·0±8·4 | 48 | 76·5±7·4 | 113 | 72·8±8·6 | 122 |
| Arteriosclerosis | 104 | 75·1±8·7 | 66 | 81·6±7·1 | 170 | 77·5±8·6 | 180 |
| Totals | 169 | | 114 | | 283 | | 302 |

Table 2. Levels of amputations, postoperative revisions and re-amputations related to the number of lower limb amputations during 1978 (n=302). Postoperative mortality, i.e. mortality within one month from the operation, is expressed in relation to the number of patients (n=283).

| | BK | | TK | | AK | | Revisions | | Re-amputations | | Postop. mortality | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % | No. | % | No. | % |
| Diabetes mellitus | 90 | 74 | 0 | 0 | 32 | 26 | 11 | 9 | 18 | 15 | 14 | 12 |
| Arteriosclerosis | 102 | 57 | 1 | 1 | 77 | 43 | 15 | 8 | 27 | 15 | 18 | 11 |
| Totals | 192 | 64 | 1 | 0 | 109 | 36 | 26 | 9 | 45 | 15 | 32 | 11 |

records seldom indicated whether or not the operation was combined with myoplasty.

2. The Ghormley-Burgess technique with a long posterior musculocutaneous flap (Ghormley, 1946; Romano and Burgess, 1971).

3. The Tracey-Persson sagittal technique with equally long lateral and medial flaps (Tracey, 1966; Persson, 1974).

In a few cases the operative report did not expressly specify the method used but considering the other amputations performed by the same surgeon or the "tradition" of the institution, a reasonable assumption could be made as to the method most likely to have been used.

The frequency of revisions, re-amputations at a higher level, and postoperative mortality associated with different surgical techniques is presented in Table 4. Plaster cast was used more frequently by "senior" surgeons (21%) compared with "junior" surgeons (16%). The frequency of re-amputations is higher in cases in which the "Fishmouth" technique was used at below-knee amputations.

The mean age for patients with the ultimate level above-knee was 75·3±8·9 years (n=152) and for patients with below-knee amputations 75·9±9·0 years (n=149).

The differences were not statistically significant.

**Discussion**

During 1978, 283 patients were amputated because of arteriosclerosis or diabetes mellitus. Patients with diabetes mellitus accounted for 40 per cent of major amputations. This figure is worth noting, as many of the series presented in the literature show a higher incidence of diabetes than of arteriosclerosis (Harris et al. 1961; Sarmiento and Warren, 1969, Fleurant and Alexander, 1980).

There is a tendency towards more proximal amputations in the arteriosclerotic patients, with 43 per cent above-knee amputations as compared to 26 per cent in the diabetic patients. The sum of postoperative complications—revisions, re-amputations at a higher level and postoperative mortality—is high and amounts to 34 per cent in the entire series. This high incidence of complications, together with the initially fairly high percentages of above-knee amputations, means that of the primary amputations in 1978 only about 60 per cent of diabetic and 40 per cent of arteriosclerotic patients were left with an intact knee joint (Table 5).

Table 3. Levels of amputation, revisions, re-amputations and postoperative mortality related to surgical experience. Percentage distribution is related to the total number of amputations for each group (senior and junior surgeons) and postoperative mortality, i.e. mortality within one month from the operation, is related to the number of patients in each group.

| | BK | | TK | | AK | | Revisions | | Re-amputations | | Postop. mortality | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % | No. | % | No. | % |
| Senior surgeon | 85 | 63 | 0 | 0 | 50 | 37 | 12 | 9 | 14 | 10 | 14 | 11 |
| Junior surgeon | 103 | 64 | 1 | 1 | 56 | 35 | 13 | 8 | 28 | 18 | 18 | 12 |
| Totals | 188* | 64 | 1 | 0 | 106* | 36 | 25* | 8 | 42* | 14 | 32* | 12 |

*In seven amputations on seven patients the experience of the surgeon is unknown. Of these seven cases four had below-knee, and three above-knee amputations, one had a revision and three were re-amputated.

Table 4. Diagnosis, surgical experience, revisions, re-amputations and postoperative mortality related to the three different methods used for below-knee amputations. The percentage distribution is related to the number of amputations (for postoperative mortality the number of patients) in each group, i.e. operation method.

| | "Fishmouth" | | Ghormley | | Persson | | Total |
|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. |
| Diabetes mellitus | 38 | 46 | 43 | 48 | 4 | 27 | 85* |
| Senior surgeon | 32 | 39 | 43 | 48 | 9 | 60 | 84* |
| Plaster cast | 21 | 25 | 24 | 27 | 9 | 60 | 54 |
| Revisions | 8 | 10 | 10 | 11 | 1 | 7 | 19* |
| Re-amputations | 22 | 27 | 16 | 18 | 2 | 13 | 40* |
| Postoperative mortality | 10 | 12 | 5 | 6 | 2 | 13 | 17 |
| Total number | 83 | | 89 | | 15 | | 187* |

*The method of operations is unknown in five below-knee amputations on diabetic patients. One amputation of these was performed by a senior surgeon, one had to be revised and three below-knee amputations were re-amputated.

The comparison between "senior" and "junior" surgeons demonstrated no significant difference regarding primary level of amputations, frequency of complications or postoperative mortality. However, the amputations performed by "junior" surgeons were complicated by re-amputations at a higher level in 18 per cent, as compared with 10 per cent in operations performed by "senior" surgeons. It can furthermore be noted that "senior" surgeons more often used Ghormley's and Persson's methods in below-knee amputations.

Plaster was scarcely used but somewhat more frequently by "senior" surgeons. In only about 20 per cent of the cases was the operation combined with a plaster cast, which is remarkable in view of the meticulous follow-up study by Mooney et al. (1971), which showed fewer healing disturbances among patients who had a rigid dressing in comparison with those with soft dressings.

The average age of our patients is comparatively high (Condon and Jordan, 1970; Persson, 1974). The mean age for women is higher than that for men and the mean age for arteriosclerosis is higher than that for diabetes mellitus.

Table 5. Results after lower limb amputations (ultimate level) during 1978 in Stockholm. Deceased patients are included.

| | BK | | KD | | AK | |
|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % |
| Diabetes mellitus | 73 | 60 | 0 | 0 | 49 | 40 |
| Arteriosclerosis | 76 | 42 | 1 | 1 | 103 | 57 |
| Totals | 149 | 50 | 1 | 0 | 152 | 50 |

The success of the amputation in terms of rehabilitation of the patient hinges on the ability to lower the level of amputation and at the same time to achieve primary healing (Fleurant and Alexander, 1980). In a recently published material from Roehampton the knee joint had been left in 67 per cent of the cases, 17 per cent had been operated with through-knee amputation and only the remaining 16 per cent had been amputated above-knee (Robinson, 1980). Compared with Burgess et al. (1971) and Fleurant and Alexander (1980), our sample has a high incidence both of above-knee amputations, re-amputations at a higher level, and postoperative mortality. We have not been able to explain the high frequency of complications by the fact that the amputations were performed by "junior" surgeons. It has earlier been pointed out that it is important that amputations are performed by experienced surgeons, and that the same surgeon takes care of the whole rehabilitation (Murdoch, 1977; Romano and Burgess, 1971). While there is every reason to believe that this is true, one wonders why it has not been reflected in our material. Our distinction between experienced and inexperienced surgeons may be too rough, but the high total number of above-knee amputations suggest that the operations were performed with an excessively wide margin with respect to circulation in the extremity, so wide in fact, that not even the more traumatic surgical technique of the less experienced surgeon could jeopardize healing of the stump. It is highly probable that if we are to obtain a higher frequency of primary healing than found in our material, improved surgical technique is needed

in order to prevent necrosis and infection in stumps with a borderline skin blood flow (Persson, 1974). Romano and Burgess (1971) feel that nearly all amputations can be carried out at below-knee level and that the only indications for above-knee amputations are severe contracture of the knee and gangrene at the operation site. The same authors also point out that it is extremely unusual for a healed below-knee stump to be amputated later at a higher level. The development of orthopaedic engineering during the last decade has made through-knee amputation a better alternative than above-knee amputations when severe contracture of the knee is present (Wagner, 1979b).

Apart from the surgical technique the attitude of the surgeon towards the rehabilitation of the patient is also important (Burgess, 1964). An analysis of individual hospitals in our material reveals large differences, probably reflecting different policies. Some hospitals for instance, have performed only above-knee amputations, perhaps with a view to providing instant relief of pain, but probably without considering the difficulties involved in the rehabilitation of the patient, even if he can only sit or lie in bed (Persson, 1974).

In 1978 the hospitals in Stockholm only rarely used Doppler ultrasound for the preoperative evaluation of the patients. Wagner reports an exceptionally high primary healing rate even for very distal amputations and it is not unlikely that the adoption of this technique could lead to more frequent preservation of the knee joint (Wagner, 1978). The average age in our material is higher than in many other published studies, and the frequency of diabetes would seem to be lower, although some earlier investigations have not presented the incidence of diabetes (Robinson, 1980). Although high mean age and low incidence of diabetes theoretically might explain the higher percentage of above-knee amputation in our material, there was no difference in average age between above-knee and below-knee amputees which is why there is reason to suspect that the operative results could be improved in future and the incidence of above-knee amputations reduced.

The analysis of our material gives us cause to believe that there is a possibility to lower the level of amputations in patients operated upon for arterial insufficiency. On the basis of the literature and our own experiences we feel that the most urgent steps to achieve this are the following:

1. To perform above-knee amputations only if below-knee amputations is contraindicated because of infection in the knee region (Romano and Burgess, 1971).

2. To abandon the "Fishmouth" method for below-knee amputations in favour of the Ghormley-Burgess and Tracey-Persson methods.

3. To refine the surgical technique, for example by never detaching skin from underlaying fascia or periosteum, or by causing damage to the edges of the wound by pulling with hooks or tearing with forceps (Burgess et al. 1971; Persson, 1974, Murdoch, 1977, Hicks and McClelland, 1980).

4. To use plaster in all below-knee amputations (Mooney et al. 1971; Murdoch, 1977, Kane and Pollak, 1980).

5. To accept longer healing periods in order to retain the original level of amputation when complications occur. This can sometimes be achieved by wedge excision of the necrosis (Murdoch, 1975), or else the patient can temporarily use an ischial tuberosity bearing prosthesis so that he can be mobilized during the healing period (Marsh et al. 1969).

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