

## Intermediate Rehabilitation Outcome in Below-knee Amputations: Descriptive Study Comparing War-related with Other Causes of Amputation

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**Aim.** To assess the intermediate rehabilitation outcome of patients with war-related below-knee amputations and compare it with the patients with other causes of amputation.

**Method.** The study comprised 74 patients with below-knee stumps admitted for rehabilitation at the Department of Physical Therapy and Rehabilitation, Split University Hospital, Croatia, in 1994. They were fitted with a preliminary prosthesis, a donation from the Finish Red Cross. The rehabilitation was performed by a professional team and included regular bandaging of the stump, exercises to prevent knee and hip joint contracture, general fitness exercises, standing-up, falling and walking exercises, and electrostimulation of the thigh muscles. The time to reach each rehabilitation phase (walking with 2 crutches, walking with 1 crutch, walking with no crutches) was measured. The satisfaction of the patients with the prosthesis was also assessed at the end of rehabilitation.

**Results.** Among 74 patients with below knee amputation, war trauma was the cause for amputation in 31 patients, and in 6 of them the amputations were bilateral. Patients with war-related below-knee amputations were younger than the patients with amputations related to vascular disease, including diabetes. The rehabilitation time was significantly shorter in patients with war-related amputations ( $61.1 \pm 11.4$  days to walking with no crutches) compared with patients with vascular disease-related amputations ( $80.9 \pm 8.1$  days;  $p < 0.001$ ). The satisfaction with the prosthesis was more variable in patients with war-related amputations than in other patients.

**Conclusion.** Early physical rehabilitation and replacement of the lost extremity with a preliminary prosthesis is an optimal intervention in below-knee amputations due to war-injury. Special attention should be paid to the psychological support to these patients during rehabilitation therapy.

**Key words:** amputation; amputation, traumatic; Bosnia and Herzegovina; Croatia; disabled persons; patient acceptance of health care; patient satisfaction; prosthesis; rehabilitation, physical; war

Missiles used in modern wars cause extremely heavy wounds (1). Antipersonnel mines are a common cause of injuries requiring limb amputation (2), and the amputation surgery has closely paralleled the progress in combat casualty care (3).

The primary treatment of the lower limb amputations consists of replacing the lost extremity with a preliminary prosthesis, where the type of surgery is crucial for the success of rehabilitation (4). The reported incidence of lower extremity amputations varies considerably among different Western countries (reviewed in ref. 6), as well as among developing countries, where landmines are the major cause of lower limb amputations (4,7).

With the wars in Croatia and neighboring Bosnia and Herzegovina, the number of patients needing physical rehabilitation and lower-limb prosthesis increased (8-10). Our Department treated patients with amputations following war-related injury along with the patients with amputations because of other dis-

eases, such as limb ischemia. However, due to the fact that only most urgent non-war related amputations were performed during the war years, the number of amputations treated in our Department did not substantially change (our unpublished observation). The aim of this report was to evaluate the rehabilitation of patients with below-knee amputations, who were fitted with a preliminary prosthesis, and compare the intermediate rehabilitation outcome of the patients with war-related amputations with that of the patients with amputations due to other causes.

### **Patients and Methods**

#### *Patients*

From January 1 to December 31, 1994, 74 patients who underwent below-knee amputation were admitted to the Department of Physiotherapy and Rehabilitation, Split University Hospital Split; these 74 unselected patients were the subjects of our study. There were 63 men and 11 women. The patients were fitted with a preliminary prosthesis, a donation from the Finish Red Cross. The prosthesis was the FRC Multiprosthesis for Above- and Below-Knee Amputees (Otto Boch, Frankfurt, Germany), with the

**Table 1.** Characteristics of the patients with below-knee amputations treated at the Department of Physical Therapy and Rehabilitation in Split University Hospital

Variable	Cause of amputation				
	war trauma	vascular disease	diabetes	accident	total
Age (years; mean $\pm$ SD, range)	46.9 $\pm$ 13.9 (23-72)	65.8 $\pm$ 8.7 (53-76)	67.8 $\pm$ 6.9 (56-76)	49.0 $\pm$ 11.0 (38-60)	57.4 $\pm$ 14.8 (23-76)
Sex (No., %)					
men	30 (97)	17 (74)	14 (78)	2 (100)	63 (85)
women	1 (3)	6 (26)	4 (22)	0 (0)	11 (15)
Amputation type (No., %)					
left	12 (39)	12 (52)	8 (44.5)	0 (0)	32 (43)
right	13 (42)	10 (44)	8 (44.5)	1 (50)	32 (43)
bilateral	6 (19)	1 (4)	2 (11)	1 (50)	10 (14)
Type of amputation suture (No., %)					
transversal	23 (74)	17 (74)	12 (67)	1 (50)	53 (72)
longitudinal	8 (26)	6 (26)	6 (33)	1 (50)	21 (28)
total (No. %)	31 (42)	23 (31)	18 (24)	2 (3)	74 (100)

following components: socket, tube with adjustment adapters, and foot (Fig. 1). All amputations not related to war-related causes were performed at the Departments of Surgery, Orthopaedics or Traumatology of the Split University Hospital. Among 31 war-related amputations (Table 1), 16 patients were from Croatia, and 15 were from Bosnia and Herzegovina. Among the patients from Bosnia and Herzegovina, primary amputations in 10 patients, performed at the local war hospital in Bosnia and Herzegovina, had to be followed by re-amputation at the Department of Orthopaedics in Split University Hospital.

#### Rehabilitation Procedure

All patients underwent preparation of the stump for preliminary prosthesis fitting. This included regular bandaging of the stump, exercises to prevent knee and hip joint contracture, general fitness exercises, standing-up, falling and walking exercises, and electrostimulation of the quadriceps femoris muscle with the Kotz's currents (5). The preconditions for the use of Kotz's currents were the following: integrity of the patellar ligament attachment site, no metal fragments in the leg (shrapnel, osteosynthetic

metrial), and integrity of the skin (5). This excluded 6 patients from this type of treatment. Sinus currents of the medium frequency were used for electrostimulations; they lasted 15 min once a day, with a gradual increase to 30 min over the period of 3 weeks. The effect of the electrostimulation on the muscle mass was followed up by measuring the circumference of the thigh muscles. The measurements were done with a tape, at three levels – 10, 20, and 30 cm above the upper border of the patella (5).

The rehabilitation of the patients with below-knee amputations was carried out according to the standardized scheme (11). Physical therapy was adapted to each individual patient but was always within the framework of the standard procedure. The rehabilitation team comprised a physician specialized in physical therapy and rehabilitation, physiotherapist, orthopedic technician, occupational therapist, and psychologist. The first two weeks of the rehabilitation took place at a surgery department and comprised respiratory physical therapy, sitting exercises in the bed, laying exercises on the nonamputated leg, sitting on a chair, and balance exercises during sitting. The therapy also included regular bandaging of the stump and its kinesiotherapy, general fitness exercises, exercise of the bed-crutches transfer, standing up with crutches, and falling and standing up with crutches. Older patients were fitted with walking frames, and younger patients were fitted with axillar crutches. In the third week, the patients were fitted with a prosthesis and exercised standing and walking exercises with the prosthesis. At this phase, older patients were fitted with axillar crutches, and younger patients with forearm crutches. There were also daily exercises of coordination and balance with the prosthesis. This was followed by walking with the prosthesis and two crutches, firstly over a flat floor, and then over a floor with obstacles (mostly of the architectonic type). Finally, the patients exercised walking with a single crutch and then without any crutches. The time needed to walk with two and then with a single crutch, as well as the time to walk with no crutches, was measured for each patient.

Each patient was asked about his/her satisfaction with the prosthesis at the release from the hospital, and the response was recorded. The interviews were individual. The questions were formulated according to the current psychological status of the patients, and the conversation was always very relaxed, without an "interrogative" component. The answers were categorized into four scores: "dissatisfied" with the prosthesis, "satisfied", "very satisfied", and "no comment".

#### Statistical Analysis

The data showed normal distribution and were expressed as means  $\pm$  standard deviation, and the differences between the groups of patients were compared using the Student t-test. Chi-square test was used to compare patients' satisfaction with the prosthesis.

## Results

War trauma was the most frequent cause of the amputation (31 patients), followed by vascular disease (23 patients) and diabetes (18 patients) (Table 1).



**Figure 1.** Components of a multiprosthesis for above- and below-knee amputees (Otto Boch, Frankfurt, Germany): socket, tube with adjustment adapters, and foot. The prosthesis was donated by the Finish Red Cross.

There were two patients with amputations related to car accident trauma. Patients with war-trauma amputations were significantly younger than other patients with below-knee amputations (Table 1). Most of the below-knee amputations were unilateral (Table 1). Among the 10 patients with bilateral below-knee amputations, war trauma was again the most frequent cause of amputation (Table 1). Transversal suture, which is better for prosthesis placement (6), was used in 72% of the cases (Table 1). There was no difference in the type of amputation suture (transversal vs. longitudinal) performed in different surgical facilities in Croatia or Bosnia and Herzegovina (data not shown).

When the patients with war-related below-knee amputations were compared with the patients with amputations due to vascular disease, including diabetes related complications, a significant difference was found in the rehabilitation time (Table 2). Patients with war related amputations had a faster rehabilitation at each of the rehabilitation steps (Table 2). There was no statistical difference in the muscle mass increase between the war-related amputees ( $1.4 \pm 0.7$  cm) and the other groups ( $1.2 \pm 0.8$  cm;  $p < 0.05$ ). As expected, patients with unilateral amputation had faster rehabilitation at each time point and greater increase in the muscle mass than the patients with bilateral amputations (Table 3). There was no difference in the rehabilitation outcome between the patients with surgery performed in war hospitals and in the Split University Hospital, the largest hospital in the region, probably because most of the patients underwent a reamputation of the stump, regardless of the place of the first amputation (data not shown).

**Table 2.** Rehabilitation time in patients with below-knee amputations according to the cause of amputation

Patient walking with	Rehabilitation time (days, mean $\pm$ SD) in patients with		
	war trauma (n=31)	vascular disease, including diabetes (n=41)	p <sup>a</sup>
2 crutches	24.9 $\pm$ 4.3	33.2 $\pm$ 3.6	<0.001
1 crutch	36.1 $\pm$ 7.3	47.6 $\pm$ 4.6	<0.001
no crutches	61.1 $\pm$ 11.4	80.9 $\pm$ 8.1	<0.001

<sup>a</sup>Student t-test.

**Table 3.** Rehabilitation time in patients with below-knee amputations according to the type of amputation

Patient walking with	Rehabilitation time (days, mean $\pm$ SD) with respect to the type of amputation		
	unilateral (n=64)	bilateral (n=10)	p <sup>a</sup>
2 crutches	28.5 $\pm$ 4.6	40.3 $\pm$ 6.9	<0.001
1 crutch	40.9 $\pm$ 6.5	59.3 $\pm$ 6.2	<0.001
no crutches	69.6 $\pm$ 11.0	99.7 $\pm$ 12.3	<0.001

<sup>a</sup>Student t-test.

**Table 4.** Satisfaction with the temporary prosthesis among the patients with below knee amputations

Satisfaction with the prosthesis	No. of patients		
	war trauma (n=31)	vascular disease (n=23)	diabetes (n=18)
Dissatisfied	6	7	6
Satisfied	18	16	12
Very satisfied	5	0	0
No comment	2	0	0
Total	31	23	18

The patients with below-knee amputations due to vascular disease, including diabetes, were mostly satisfied with their prostheses (70% and 67% for vascular disease and diabetes, respectively), and about a third of them were not satisfied (Table 4). Among the patients with war-related below-knee amputations, the satisfaction with the prosthesis was significantly more variable (Table 4). More than half of the patients were satisfied with the prosthesis. Contrary to other patients, among those with war related injuries there were those who were delighted with the prosthesis, as well as those who did not make any comment on the prosthesis, but were very irritable and often quit daily rehabilitation exercise before its end.

## Discussion

Our study showed that the patients with below-knee amputations due to war injury had a faster rehabilitation adaptation to the preliminary prosthesis compared with the patients with amputations due to other causes. Since the assessment of functional outcome differs greatly from one study on the rehabilitation of lower limb amputees to another (6), it was difficult to compare our results with the results of other authors. Also, the complete evaluation of the rehabilitation outcome in our patients, ie, fitting of a permanent prosthesis and adaptation to it, was not possible because the patients left our institution with a temporary prosthesis and continued with the rehabilitation and final prosthesis fitting in other institutions. Dürriegl and Jelić (11) reported longer and poorer outcome of rehabilitation in persons with lower limb amputations in another Croatian institution than the one we found in our study. It is difficult to compare the results because of the heterogeneity of the patients included these two studies. However, the Split Rehabilitation Department is a small institution, where the professional team works with a smaller group of patients, thus closer interaction between the staff and the patients and individual approach to each patient may explain our good rehabilitation results. Also, the Department is in the vicinity of the old Roman palace and the sea promenade, which provides pleasant setting for rehabilitation – the first walk for the patients outside the Department was along the promenade and they looked forward to it.

Longer rehabilitation time and dependence on crutches in the patients with amputations due to vascular diseases or diabetes-related complication could be explained by different factors. Older age and weaker general muscular fitness of these patients are the most important because increasing age, concurrent disease, and poor compliance have been shown as prognostic factors for a low functional level after rehabilitation (6). Also, presence of other diseases and cultural background could have influenced the rehabilitation outcome. Our study was descriptive and did not enable the analysis of various variables, but it is clear that more research is needed to elucidate the contribution of cultural, comorbid, psychological factors to the rehabilitation outcome in lower limb amputees.

The most difficult part of the rehabilitation was normal forward walking and walking backwards (6). Further exercise makes a patient more confident in his or her walk, less and less dependent on the crutches, and he or she accepts the prosthesis as an inevitable part of the walk, and gradually discontinues the use of two and than of a single crutch. In our patients, this was achieved in about two months in patients with unilateral below-knee amputations, whereas the patients with bilateral amputations needed another month to be able to walk without crutches.

The satisfaction with a temporary prosthesis among the patients with war-related amputations showed a significantly greater variation than among the patients with vascular causes of amputation. Most of the patients with war-related amputation made a realistic assessment of the situation and accepted the loss of the extremity and the need for a most adequate functional replacement. They were most cooperative during the rehabilitation program and had the best results in achieving independent walking and psychological and physical adaptation to the prosthesis. The second largest group of war trauma amputees was greatly dissatisfied with the prosthesis. Their complaints ranged from poor fitting of the prosthesis, its heaviness, difficulty in walking with it to the feeling of self-pity ("I did not deserve such a poor prostheses.") and demands for better prosthesis. This group did not accept the loss of the extremity and the cooperation during the rehabilitation program was poor. Another group of patients were delighted with the prosthesis and did not have any complaint but just praise – a patient even slept with his prosthesis for the first week. The smallest number of patients did not want to make any comment about the prosthesis, but were very irritable and easily quit the current rehabilitation exercise. Such variation in the satisfaction among war-related amputees compared with patients with amputations from vascular causes can be explained by their younger age and war-related psychological stress. Patients with war-related amputations had a more difficult adaptation to the new situation, burdened with the loss of family, friends, and property; they often had combat experience and they and their families were refugees. Also, younger age of these patients and sudden loss of the extremity made it harder for them to adapt psychologically to the new situation. The descriptive nature of our study did not allow detailed investigation into these factors and their influence on the rehabilitation outcome. Moreover, at that time the diagnosis and studies of the post-traumatic stress disorder just started in Croatia (12) and we had no trained professionals to assess the psychological disturbances in our patients. However, our team provided psychosocial support to the patients, especially to those with war-related trauma, and worked individually on each case.

In conclusion, we showed that the rehabilitation of patients with war-related below-knee amputations was faster than in patients with other causes of ampu-

tations. Because of their younger age, patients with war-related amputations had better rehabilitation outcome, but had more a more variable psychological adaptation to the loss of the extremity and prosthesis. Early rehabilitation with a temporary prosthesis seems to be an efficient method for rehabilitation of patients with war-related injuries. Physical therapy of patients with war-related amputations should also include psychological support as an important factor in the adaptation to the temporary prosthesis.

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