297. Physical capacity and balance ability after lower limb amputation

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Abstract. The mean causes of lower extremity amputation, and the main goals and means of comprehensive rehabilitation in period of prior to surgery, acute postoperative and prosthetic training has been presented in this paper. In the paper are described most common problems after lower limb amputation, such as deterioration of muscle strength and balance and scientific search of optimal rehabilitation programs for patients after lower limb amputation on regaining and development balance and walking ability. It was formed some conclusions: applied individual comprehensive rehabilitation program increase lower limb amputees physical capacity and functional independence; properly selected and fitted lower limb prosthesis improves patients balance and walking abilities.

Keywords: lower limb amputation, prosthetics, physical capacity, balance ability.

Introduction

Most of the lower extremity amputations occur in individuals older than 60 years because of complications of medical disease [1]. Diabetes and peripheral vascular disease are the leading complications of medical disease requiring amputation, followed by thromboembolism and vasculitis. Those with diabetes often have other end-organ disease, such as blindness, end-stage renal disease, and peripheral neuropathy. Mortality in this group approaches 50% at 2 years and 70% at 5 years [1]. For up to one fifth of patients, amputation of the contralateral extremity is needed within the first 2 years after the initial amputation.

Trauma is the second most common cause of lower extremity amputation and typically occurs in the young male population. Tumors and congenital malformations less commonly result in lower extremity amputation [1].

The goal of amputee rehabilitation is to aid the amputee in reentering and regaining his or her place in society: working, playing, and engaging in a full range of human relationships [2]. Optimal rehabilitation requires an underlying commitment in many essential areas of care: for one, sensitivity to the desires, anxieties and fears of the individual with amputation [3].

Since most of the lower extremity amputations are the result of disease, the rehabilitation team often is able to meet with the patient prior to surgery [1], [2]. During this time, an assessment of the patient's postoperative needs and desires can be made, and range of motion (ROM) exercises, strengthening, and activities of daily living (ADL) training can be initiated. Successful prosthetic ambulation after amputation is associated with independent prior ambulation, ability to bear weight on the contralateral leg, stable medical status, and ability to follow directions. Besides preoperative assessment of those undergoing amputation to determine candidates for prosthesis should include exercise testing using arm ergometry.

Acute postoperative rehabilitation includes efforts at early mobilization, prevention of contractures; wound healing, pain management; shaping of the stump and physical and occupational therapy to train the patient to perform ADL, mobility, ROM, and strength. Besides it involves progressive ambulation with parallel bars, teaching about prosthesis and stump care, and monitoring for stump injury.

In phase of prosthetic training initially the patients are teached the basics of prosthetics care, including how to on and off the prosthesis, how to inspect the residual limb for signs of skin breakdown, and how to perform safe transfers (moving from one position or surface to another). Here are included exercises for general conditioning, stretching of the hip and knee, strengthening of all arm and

leg muscles, and standing and balancing exercises. Then, emphasis is shift to weight bearing with the prosthesis. Finally, ambulation on level surfaces with a walker or other assistive device is promoted. Once the patient has mastered these skills, training on stairs, uneven surfaces, and ramps/inclines is begun. The end goal is - safely ambulate on all usual surfaces without adaptive equipment. Younger amputees may be taught to run and indeed participate in many athletic activities.

The most common problems after lower limb amputation are deterioration of muscle strength and balance, problems in weight bearing, and increase of energy consumption (an individual who has a lower extremity amputation and requires a walker or crutches to ambulate uses 65% more energy than someone with a normal gait) [4], [5], [6]. A systematic search of literature for influence of physical capacity (expressed by aerobic and anaerobic capacity, muscle force, flexibility and balance) on regaining and development walking ability (expressed by walking velocity and symmetry) revealed strong evidence only for a relation between balance and walking ability [7]. Evidence about a relation between other elements of physical capacity and walking ability was insufficient. Thus search of optimal rehabilitation programs for patients after lower limb amputation is actual scientific problem [4], [6], [7], [8].

The aim of the study was to evaluate the effect of comprehensive rehabilitation program on physical capacity and functional independence in patients after lower limb amputation.

Analysed material and applied methods

Were analyzed 6 patients after lower limb amputation: 3 patients underwent amputation above the knee, 3 patients – below the knee. The youngest patient was 35 years old and the oldest one was 67 years old ($\overline{x}$=47,3; s=8,5)[1]. Male were dominated (totally 70 %). Time after amputation was in the interval from 2 to 4 months ($\overline{x}$=2,7; s=0,9).

All patients were applied basic complex rehabilitation program: physiotherapy 3 times per day (2,0–2,5 h/day), occupational therapy 2–3 times per day (1,5–2,0 h/d), massage, muscle electrostimulation, psychotherapy, compensatory aids adaptation, social worker's consultation. A lower extremity prosthesis fitting was made to all patients. The technological sophistication of the prosthetic device was made according specialized orthopedic company's technology: including prosthesis calibration, symmetry axis regulation, the center's of gravity balance.

The patients physical capacity was measured by muscle strength, balance and walking ability. To evaluate muscle strength we used Lowett scale; balance – Mtd balance system; walking ability – 10 meters walking test, measuring walking speed and heart rate changes. The patients functional independence was evaluated by FIM (functional independence measurement) instrument, version 4,0 (B. B. Hamilton, C. V. Granger, S. Sherwin etc., 1987; Version 4,0 Buffalo, NY 14214: State University of New York at Buffalo, 1993).

On the first days of arrival to rehabilitation centre were evaluated indices of patient's physical capacity and functional independence. Repeated evaluation was made after 4 weeks.

Data were analysed using STATISTICA program. A dependent t test was used to compare the changes of characteristics during rehabilitation. A p-value of less than 0,05 was regarded as statistically significant.

Results and Discussion

Applied individual comprehensive rehabilitation program significantly increase patients muscle strength (approximately 1 – 1,5 points above initial points) and functional independence (approximately 20 – 27 points above initial points), particularly ability to transfer and to move ($p<0,05$).

Properly selected and fitted lower limb prosthesis improves patients balance ability: improves static and dynamic balance (evaluated on mtd balance platform), their transfers from one position or surface to another; and ability to walk: at the beginning of rehabilitation walking speed during 10 meters test is approximately 30 seconds; at the end of rehabilitation it decreases to 15 seconds ($p<0,05$).

In studies by other scientists [4], [6], [7], [8] active rehabilitation means (physiotherapy, occupational therapy and psychotherapy) are considered very useful in cases of prosthetic training after lower limb amputation. The results of our study have indicated the same.

Because of our failure to find studies analysing the effect of training on mtd balance system patients after lower limb amputation, on the base of our study we can propose that amputees are expedient to apply individual balance training program to improve their physical capacity and functional independence.

Conclusions

1. Applied individual comprehensive rehabilitation program increase lower limb amputees physical capacity and functional independence.

2. Properly selected and fitted lower limb prosthesis improves patients balance and walking abilities.

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[1] The symbol $\overline{x}$ is the arithmetical mean and symbol s is a standard deviation.

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