Improvement of functional ability by electrical stimulation in persons after trans femoral amputation

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Abstract

The aim of the present study was to find out if electrical stimulation of the great gluteal muscle can improve the control of unlocked prosthetic knee and functional abilities of persons after trans femoral amputation.

32 males after trans femoral amputation who came to the first rehabilitation were divided into two groups of 16 persons, a group with electrical stimulation (ES group) and a control group.

All subjects participated in the standard rehabilitation program. The gluteus maximus muscle on the amputated side of subjects of the ES group was electrically stimulated.

Before discharge the ability to control unlocked prosthetic knees, walking time, need of additional support and ability to climb stairs have been evaluated.

More subjects from stimulated group were able to control unlocked prosthetic knee and climb stairs. They were also able to walk longer with less additional.

1. Introduction

In spite of lightweight and energy efficient prosthetic limb systems that have made prosthetic limb fitting and walking possible for an expanded number of patients with amputation 15, Nissen 14 reported impairment with ambulating in the community of most persons after lower limb amputation.

After a trans-femoral amputation the morphology of the muscles around the hip joint at the amputated side altered 8, 9. The muscles on the amputated side become weaker 8, 9. The changes are in correlation with the stump length. Already Harris in 1944 4 stressed the importance of well functioning stump for prosthetic fitting. For stability and control of unlocked prosthetic knee in persons after trans-femoral amputation the hip extensors, specially the great gluteal muscle, which remains the only uncut hip extensor, is important.

The strength and the endurance of skeletal muscles can be improved by exercises and also by electrical stimulation 2, 3, 18, 19, 21, 22. Kondrashin 12 and Roganov 17 stimulated many stump muscles at rest and during walking. They reported that they improved strength and also gait of the patients.

The aim of the present study was to strengthen the great gluteal muscle in order to improve the control of unlocked prosthetic knee and functional ability of persons after trans femoral amputation.

2. Subjects and methods

32 males after trans femoral amputation who came to the first rehabilitation and did not walk with a prosthesis before, were divided into two groups of 16 persons, a group with electrical stimulation (ES group) and a control group. There was no difference between the two groups in age (The mean age of stimulated group was 59.5 (SD 9.4) years and of control group 58.5 (SD 11.6) years), cause of amputation, condition of the stump, walking distance, climbing stairs and need of support. Persons also had no other disease that can influence the rehabilitation outcome or limit the prescription of the prosthesis as stroke, heart disease, paresis, paralysis,...

All subjects participated in the standard rehabilitation program. The great gluteal muscle on the amputated side of subjects of the ES group was electrically stimulated 3 weeks 1 hour per day.

Before discharge have been evaluated the ability to control unlocked prosthetic knee, daily walking time, need of additional support while walking 10 meters and ability to climb 10 stairs up and down.
3. Results

All persons got a prosthesis with a quadrilateral socket. Six persons of ES group and three from control group controlled unlocked prosthetic knee and also got it. Others were not able to control an unlocked knee and got a prosthesis with a locked knee ($p < .05$).

Persons from the ES group walked significantly more before discharge than persons from the control group ($\chi^2 = 11.9$, $p < .01$).

Persons from the ES group also need significantly less additional support while walking than persons from the control group ($\chi^2 = 5.4$, $p < .05$).

All persons from the ES group were able to climb stairs. Five persons of the control group were not able to climb stairs at discharge.

4. Discussion

One of the main goals in rehabilitation after lower limb amputation is successful ambulation. A preliminary condition for ambulation after trans femoral amputation is successful control of the above-knee prosthesis. For good prosthetic control a person needs strong muscles of the stump and good range of movement. With electrical stimulation of the great gluteal muscle on the amputated side the muscle becomes stronger and persons better control unlocked prosthetic knee.

Walking distance, additional support and ability to climb stairs are all important for independence in daily activities such as shopping, visiting friends, relatives and public places. To short walking distance may lead to social isolation and dependence on other people.

A person after lower limb amputation must be able to walk 600 steps a day to manage independently in a one-level house or apartment and 1100 - 1450 steps a day to live independently in a one- or two- level dwelling. These daily minimums do not include activities outside the home such as shopping. We have not counted the steps but the walking time of ES group was longer what means that they are able to make more steps.

Additional support impedes several daily activities, specially if person needs two crutches. They have troubles with carrying things like glasses, plates, books, when shopping, with cleaning and cooking. Persons of ES group need less additional support and because of this they are more independent.

Many persons do not have stairs at home but in Slovenia are still many public places and institutions with stairs and there persons who can not climb them have problems.

Siriwardena and Narag reported that with aging persons have more disabilities, Kihn, Katrak and Pohjolainen that many persons some years after the amputation do not use their prosthesis any more. Because of this we believe that the rehabilitation outcome and functional ability after the first rehabilitation are very important. The better they are the better is persons starting position and he or she may be longer independent. With electrical stimulation of the great gluteal muscle on the amputated side of persons after trans-femoral amputation we can effectively improve the functional abilities of these persons.

5. Conclusion

Electrical stimulation of the great gluteal muscle improves hip extension of persons after trans femoral amputation and their functional abilities. Because of this it is a good additional therapeutic technique in rehabilitation of persons after trans femoral amputation.

References


