

INFLUENCE OF AMPUTATION LEVEL ON PROSTHETIC WALKING IN OLDER PATIENTS

M. Zalar
Institute for Rehabilitation, Ljubljana, Slovenia

Abstract

The aim of the study was to confirm that the level of amputation influenced walking speed and endurance in older patients. The study included 16 subjects, from 62 to 82 years old with TF (transfemoral) or TT (transtibial) amputation.

The speed was measured as the time needed to cover the distance of 10 meters. The endurance was measured as the distance covered in 6 minutes. The subjects were tested when receiving the prosthesis and after 14 days of its use.

INTRODUCTION

Gait is a basic everyday activity of humans and it does not require special attention. It can become a problem when changes of neuromuscular and skeletal systems occur.

In persons with TT amputation the muscular activity of the sound leg during stance phase is normal or very similar (1). On the contrary the amputated side shows reduced activity of knee extensors (1). The toe - off is weak because of the absence of plantar flexors. Extensors of the hip take over the work of plantar flexors. The swing phase is normal on both sides (1).

Sensorymotor function of the leg after TF amputation is strongly reduced. To achieve stability the person should change his or her gait pattern. In the first 30-40 % of the stance phase the person must not allow any flexion of the prosthetic knee. At that time, the activity of hip extensors must increase extremely. The toe- off is normally made by cocontraction of plantar flexors and hip extensors. In person with TF amputation, even though the prosthesis weighs 30 % of the weight of the leg, the hip extensors must generate equal strength of contraction because of the absence of plantar flexors. When the stance phase of the sound leg is observed, one can see increased activity of hip extensors and plantar flexors. In that manner, the person compensates for the absence of toe -off on the amputated side. Sometimes increased activity can be seen in plantar flexors of the sound leg, which causes raising of the body' center of gravity. The swing phase with prosthesis is easier (1).

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METHODS AND SUBJECTS

Methods

The speed was measured as the time needed to cover the distance of 10 meters. The endurance was measured as the distance covered in 6 minutes. The subjects were tested when receiving the prosthesis and after 14 days of its use.

To measure the speed and endurance a stop watch and a tape measure were used. The results were statistically analysed with SPSS software. T- test , paired T- test and Pearson's coefficient of correlation were used.

Subjects

The study included 16 subjects, all of them after TF or TT amputation. The subjects were from 62 to 82 years old. In each group there were 6 man and 2 women. The subjects had normal ROM (range of motion) of joints, were capable of walking with crutches and had no severe problems with the sound leg. They were all involved in the rehabilitation program at the Institute for Rehabilitation, Republic of Slovenia in Ljubljana. All the subjects were fitted with the prosthesis (PTB prosthesis or above knee prosthesis with locked knee).

RESULTS

A significant increase in walking speed after 14 days of training was found in both groups of subjects ($p=0.000$). Walking endurance improved significantly after 14 days of training in both groups ($p=0.001$; $p=0.003$).

Even at the second measurement, the subjects after TF amputation did not reach the walking speed of the subjects with TT amputation at the first measurement ($p=0.001$). Walking endurance improved in subjects after TF amputation at the second measurement, however, it did not reach the endurance of the subjects after TT amputation at the first measurement ($p=0.001$; $p=0.000$).

The Pearson's coefficient of correlation showed that there was no statistically significant correlation between the length of the stump and the speed and endurance of walking. Also, there was no statistically significant correlation between the age of the subjects and the speed and endurance of walking (independently of the level of amputation), except at the first measurement of walking speed ($p=0.037$).

DISCUSSION

On the basis of everyday clinical practice the amputation at TT level is said to be more favourable than the amputation at TF level.

The manner of walking depends on age and sex. Older patients walk more slowly, because it is safer. The research on older persons has found the speed in optimal walking to range between 60 to 100 m/min (women - 74m/min ; men - 82m/min)(2). The results of the present study showed that the level of amputation influenced the walking speed. The subjects with TT amputation walked faster than the subjects with TF amputation. Even at the second measurement the subjects after TF amputation even after second measurement did not reach the walking speed of the subjects after TT amputation at the first measurement.

The level of amputation influences energy expenditure as well as walking speed and endurance. Erjavec (2) states that in persons after TT amputation the oxygen uptake $-VO_2$ is 12.0ml/kg min and the cost index is 0.33ml/kg m . The walking speed with that energy expenditure is 36.2 m/min. In persons after TF amputation, VO_2 is 14.9 ml/kg min and the cost index is 0.52 ml/kg min. With that energy expenditure, the walking speed is 28.2 m/min.

Burger (3) compares healthy persons with persons after TT and TF amputation. The subjects were tested with Fullart Functional Test and with Balance Test (Tsukuba Functional Age Inventory). The results showed that the level of ampu-

tation influenced activities such as: balance, standing up from chair, walking on the spot, walking distance (in 9 min TT - 441 m ; in 9 min TF -287 m).

Waters (4) finds that persons with TT amputation walk at a speed of 45m/min (59 % of normal gait speed), while persons with TF amputation walk at a speed of 36m/ min (44 % of normal gait speed). The present study found that the average speed in persons after TT amputation at the first measurement was 29 m/min and at the second measurement 34 m/min. The average speed in persons with TF amputation at the first measurement was 22 m/min and at the second measurement 25 m/min.

The difference between both studies is that Waters measured his subjects after 6 month of using the prosthesis, while the present study measured the subjects after 14 days.

CONCLUSION

It can be concluded that the level of amputation influences the speed and endurance of walking. The remaining knee joint is very important for walking with prosthesis and influences rehabilitation outcome.

References:

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