WEIGHT-BEARING TRAINING WITH SMARTSTEP BIOFEEDBACK SYSTEM

S. Drole, H. Burger, M. Rudolf
Institute for Rehabilitation, Ljubljana, Slovenia

Abstract

The article discusses weight-bearing training on the impaired lower limb during gait with SmartStep biofeedback system on patients after stroke and lower-limb amputation. The aim of the present study was to find out whether by using SmartStep biofeedback system, which gave the patients a sound signal when they put enough weight on the impaired limb, the weight bearing and gait pattern could be improved. The study found that by using SmartStep biofeedback system the weight bearing of the hind foot and the whole foot increased as well as the patients' self-confidence and safety.

INTRODUCTION

Most patients admitted for rehabilitation have gait problems. Patients after fractures and joint replacement are not allowed to walk with full weight bearing whereas stroke patients and amputees do not put enough weight on the impaired lower limb or on the prosthesis. Gait training is one of the most frequently used trainings by means of which, physiotherapists try to teach patients the appropriate weight bearing with different physiotherapeutic methods and approaches (1-6). Until now, there has been no simple method to confirm the success of their work.

The aim of the present study was to find out whether by using SmartStep biofeedback system, which gave the patients a sound signal when they put enough weight on the impaired, limb the weight bearing and gait pattern could be improved.

METHODS AND SUBJECTS

Methods

SmartStep system consists of a flexible polyurethane insole containing two separate air pockets and a wireless control unite which is attached to the patient's ankle. The control unite has two pressure sensors, each connected to one insole air pocket. In addition, the system also consists of an air pump for inflating the insole, a laptop with SmartStep software and a USB-key which allows wireless connection between the control unit and the computer.

Weight bearing was tested in standing position, transfer from sitting to standing and during walking.

Subjects

Fifteen stroke patients and nine lower-limb amputees were included into the study. All of them were admitted for the first rehabilitation at the Institute for Rehabilitation in Ljubljana. The inclusion criteria were the following: the patients had to be aged from 18 to 85; full weight bearing had to be allowed; the patients had to be able to walk at least 10 meters; they had to fully cooperate and to sign a written consent. The patients were randomly divided into a control and a training group.

Both groups used the SmartStep system during their physiotherapy sessions; in the control group the system was switched off. Each day before starting physiotherapy, the therapist measured the weight bearing and in the training group he adjusted the sound signal to be triggered when the weight bearing would exceed the initial level increased by ten percent of a patient's body weight. When starting the training, the therapist measured the weight bearing, gait velocity, 10m walking test, cadence, swing-stance phase ratio and FIM score. The patients after stroke started training with SmartStep immediately after the admission, the patients after lower-limb amputation started training after having been fit with prosthesis (the second week after the admission).

RESULTS

Thirteen out of twenty-four patients were in the control and eleven in the training group.

There were five amputees in the control group and four in the training group. There were eight stroke patients in the control group and seven in the training group. The study included

sixteen male and eight female patients. The average age was 60.2. The rehabilitation of stroke patients took six weeks on average, the rehabilitation of lower-limb amputees took five weeks on. At the beginning of the therapy, there were no significant differences between both groups in regard to the subjects' age, height, gender, diagnosis, need of walking aids, total FIM score, weight bearing of the impaired lower limb or the prosthesis on the whole sole, hind and fore part, stance and swing phase, cadence, gait velocity and 10m walking tests.

At the end of the study, the patients in the training group put 12.88 percent more of their body weight on the impaired side, whereas the patients in the control group put only 2.43 percent more. In all the other measured parameters, there were no differences between the two groups. However, differences between the amputees and the stroke patients were observed.

DISCUSSION

In spite of the small number of included patients and short duration of the therapy, the study found that by using biofeedback system the weight bearing of the hind foot and the whole foot increased. Those are the two main aims of physiotherapy since they also contribute to the prevention of osteoporosis. In addition, the patients' self-confidence and safety increased. Slightly greater improvement was observed in lower-limb amputees. The study did not succeed to demonstrate that using biofeedback system improved functional walking (gait velocity, 10m test, cadence, swing and stance phase and total FIM score). The patients put too much attention on weight bearing of the impaired limb during walking, which caused the symmetry of walking to become worse. The stance phase became longer and the swing phase shorter. Those pesults suggests that it would be appropriate to consider training weight bearing with SmartStep biofeedback system only in standing position and then after improved weight bearing in standing position one could begin weight bearing training during walking without SamrtStep system. The study did not succeed to demonstrate that using SmartStep system could save some time for the physiotherapist. Preparing the system and the patient was very time consuming.

More patients would need to be included into the study to reach firm evidence of the method but the first results were promising.

CONCLUSION

In spite of the small number of included patients and short duration of the therapy the study found out that by using SmartStep biofeedback system the weight bearing of the hind foot and the whole foot increased. However, preparing the system and the patient was more time consuming that it had been expected.

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