Evaluation of electrical stimulation of gait and posture in elderly people

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Abstract

Aging is associated with an increased risk of falling resulting from muscle weakness, and so on. The purpose of this study was to evaluate the effects of electrical stimulation of gait and posture in elderly people. Four female subjects over 75 years of age were enrolled. We were evaluating the effectiveness of electrical stimulation by the change of the center of gravity in standing, the kinematic parameters during gait. The patients were stimulated at the motor point of paraspinal muscle (L3-4 level) and received stimulation for 20 minutes, 3 times a week, for 4 weeks. At the 4-weeks follow-up, they demonstrated a slight improvement in the gross area of center of pressure and the gait velocity. The electrical stimulation of the paraspinal muscle was effective for the standing and gait performance, however it was useful over prolonged periods.

1 Introduction

Aging is associated with an increased risk of falling resulting from visual and sensory disturbances, muscle weakness, and difficulties with gait and balance. Paraspinal muscles change spinal posture and affect as a stress concentration for the vertebral column [1]. The thoracic kyphosis may be influenced especially by changes in the back extensor strength[2], [3], the back extensor strength and lumbar spinal mobility are the important factors for Quality of Life in patients with postmenopausal osteoporosis[4].

The back extensor weakness makes the deformities of the spine, the back pain due to the muscle fatigue, the limitation of the Activities of Daily Living and standing balance, gait performance. The aim of this study was to evaluate the influence of electrical stimulation for the standing and the gait performance in elderly people.

2 Methods

2.1 Subjects

Four female subjects over 75 years of age were enrolled. The average age was 79 years, average height 1.45m, and average weight was 52.1kg. They got an osteoporosis diagnosis and were treated with medication.

2.2 Materials

We are evaluating the effectiveness of electrical stimulation by the change of the center of pressure in standing and the gait performance before and after intervention. The distance of the centers of pressure while standing motionless, was measured at the force plate (9281B, Kistler). While standing on the force plate, the floor reaction force digitized at a rate of 20 Hz per 20 seconds. The gait performance was examined using the VICON motion analysis system. The subjects walked at a self-selected speed without

Fig. 1 Gait performance was measured using the VICON motion analysis system. Twenty-two light-reflecting markers were placed on anatomic landmarks bilaterally.
The electrical Stimulation was performed using the Dynamid DM2500 stimulator. The patients were stimulated the motor point of the paraspinal muscle (L3-4 level).

stimulation, and the movements of the markers were recorded at a frequency of 60 Hz by six infrared cameras. Each pair of cameras were placed 2.5 m above the ground. Twenty-two light-reflecting markers were placed on anatomic landmarks bilaterally: on the manubrium of sternum, processus xiphoideus, C7, T10, acromions, anterior superior iliac spine, posterior superior iliac spine, the thigh bone, the external part of the lateral femoral condyles, the tibia bone, the lateral malleoli, the toes, and the heels (Fig 1). The gait velocity was calculated by these kinematic data.

2.3 Electrical Stimulation

The patients were stimulated at the motor point of paraspinal muscle (L3-4 level). The device of the stimulation was used Dynamid DM2500 (MINATO MEDICAL SCIENCE Co, LTD. Japan)

Stimulation was performed at a frequency of 20 Hz and constant current was adjusted to give maximum contraction force in a lying position. The 10-second stimulation cycle included a 5 second burst on and 5 seconds off. The protocol of this study is to receive stimulation of the paraspinal muscle for 4 weeks. The patient received stimulation for 20 minutes, 3 times a week, and then gradually increased the amount of stimulation until reaching a maximum contraction. All patients didn’t received additional therapies e.g. physiotherapy during the four week period.

3 Results

It showed a tendency to decrease the distance of the centers of pressure, to increase the gait velocity in patients. The distances of the centers of pressure were 198 +/- 36.9 mm before stimulation, and 178 +/- 34.2 mm after stimulation. The gait velocities were 37.2 +/- 5.2 m/min before stimulation, and 40.5 +/- 4.8 m/min after stimulation. However, there is no significant difference in either of the parameters.

4 Discussion

Previous research has demonstrated that the development of postural deformity in osteoporosis may be influenced by vertebral fractures due to bone loss, changes in the intervertebral disc, and changes in spinal soft tissues[2]. Sinaki M, at al. suggested that skeletal health depends not only on bone structure but also on strong supportive muscles[3]. The back muscles make the spinal motion backwardly. The stress distribution was observed in lumbar vertebra[6]. In this study, we had good results for the performance after electrical stimulation, however, these parameters were not showed significant improvement. Many studies have indicated that the main supportive muscles of the spine are extensors[3], [5]. Therefore, provision of strong, natural extrinsic support for the spine seems to be important to decrease the incidence of spinal deformity[2], to increase the standing and gait performance.

In this study, the data did not show significant improvement due to limited periods, so it was planned over prolonged periods of stimulation.

5 Conclusion

The electrical stimulation on paraspinal muscle in elderly people showed a tendency for the static balance and gait performance after stimulation.

6 Literature


