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LETTER TO THE EDITOR

Stroke-related atrophic muscle group strengthening with an isokinetic dynamometer

İnmeye bağlı atrofik kas grubunun izokinetik dinamometre ile kuvvetlendirilmesi

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To the Editor,

Gait disorders can be observed in post-stroke hemiplegia patients. Unstable gait, lack of intermuscular coordination, and asymmetric gait patterns increase the risk of falling[1,2]. Deficits in certain muscle groups, such as ankle dorsiflexors and plantar flexors together with knee flexors, may also interfere with walking performance and gait speed[3]. In this regard, strengthening relevant muscle groups can improve gait in patients with hemiplegia. Isokinetic dynamometers are generally used for efficient muscle-strengthening rehabilitation applications and training isolated muscle groups[4]. Improving muscle strength in a controlled manner with an isokinetic dynamometer may increase patients' daily active time and enable them to return to their everyday activities[5,6]. This article aims to raise awareness regarding the potential benefits of isokinetic training in improving muscle strength and facilitating the adaptation of hemiplegic patients to daily life.

A 38-year-old male patient with right-sided hemiplegia was admitted to the Department of Physiology, Division of Sports Physiology, following the neurological and physical evaluation for strengthening exercises of the lower limb. On the first visit day, verbal and written informed consent was obtained from the patient. On medical history, the patient had an ischemic stroke 13 months ago and was heterozygous for Factor-V H1299R and methylenetetrahydrofolate reductase-C677. The patient could walk independently with an unstable and asymmetric gait pattern. Deep tendon reflexes were hyperactive, and the Babinski reflex was positive on the right side. Thigh circumference measurements were performed 10 cm and 15 cm above the patella with an inelastic tape. The values were 46.7 cm and 51 cm for the right leg and 51.5 cm and 56.8 cm for the left leg, respectively. This condition indicates muscular atrophy in the hemiplegic side. Anthropometric measurements were performed using a skinfold caliper (Holtain Ltd., UK) from both sides of the body. The right-side measurements showed that the patient had 13.0% body fat and 40.8% muscle mass; the left-side measurements presented 14.0% body fat and 43.5% muscle mass.

Following anthropometric measurements, the physical activity capacity of the patient was evaluated with a six-minute walking test. The patient walked 520 meters, and according to the International Physical Activity Questionnaire-Short Form, the patient's physical capacity status was classified as minimally active (category 2). The patient's muscle concentric contraction strength was assessed bilaterally by an isokinetic dynamometer (Cybex Norm, CSMI, USA) at angular velocities of 60°/sec and 240°/sec. Before the isokinetic test, the patient warmed up for 10 minutes on a bicycle ergometer. At 60°/sec, the results showed a 32% and 20% deficit in the right leg extensor and flexor muscles compared

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to the left leg, respectively. At an angular velocity of 240°/sec, the deficit of the right leg was found to be 19% and 72% for the extensor and flexor muscles, respectively.

After the initial evaluation, the patient was enrolled in a four-week strengthening program four days a week. The angular velocity was reduced weekly to increase the intensity of the training. It has been shown previously that isokinetic contractions at lower angular velocities improve the explosive force, whereas higher angular velocities improve the endurance of the muscle. In the first week, rehabilitation was performed at 240^0/sec 10 repetitions-2 sets, 210^0/sec 10 repetitions-2 sets, 180^0/sec 10 repetitions-2 sets, 210^0/sec 10 repetitions-2 sets, 240^0/sec 10 repetitions-2 sets, respectively. Between consecutive sets, a one-minute recovery time was given to the patient. Following every fourth training session, angular velocities were reduced by 30^0/sec in the first three weeks. In the last training session, the protocol was adjusted as 240^0/sec 10 repetitions (1 set), 180^0/sec 10 repetitions (1 set), 120^0/sec 7 repetitions (1 set), 60^0/sec 7 repetitions (3 sets), 120^0/sec 7 repetitions (1 set) and, 180^0/sec 10 repetitions (1 set).

Following the four-week isokinetic rehabilitation program, the same investigator repeated initial measurements. Thigh circumference was measured as 49.2cm and 53.4cm for the right leg and 52.4cm and 57 cm for the left leg at 10 cm and 15 cm above the patella, respectively. The improvement in the thigh circumference of the hemiplegic extremity indicates that the isokinetic dynamometer training program efficiently increased muscle mass. The anthropometric measurements from the right side of the body showed that muscle mass increased by 4.2% without changing the body fat content (13.0% body fat and 42.5% muscle mass). Similar measurements on the left side showed improved muscle mass at the hemiplegic extremity (12.2% body fat and 44.0% muscle mass). In addition, the patient walked 600 meters in the six-minute walking test, corresponding to a 15.4% increase.

At the end of the training period, the isokinetic muscle strength of both legs was tested with the same protocol. The results showed that the strength deficit decreased to 21% in the extensor group and 2% in the flexor group at 60^0/sec. Also, the deficit was reduced to 14% in the extensor group and 31% in the flexor group at 240^0/sec. The physical activity questionnaire was repeated, and according to the given answers, the patient was grouped as very active (category 3).

These results revealed the efficiency of an isokinetic lower extremity-strengthening program in a patient with post-stroke hemiplegia. The results showed an increase in the thigh muscle mass and circumference, indicating the importance of individually adjusted muscle group loading to induce an adaptive response. It was shown that an increase in muscle mass may support metabolic well-being and delay the onset of metabolic diseases[7,8]. Exercise-induced muscle adaptations are correlated with mitochondrial biogenesis and increase in insulin sensitivity. Moreover, there are reports about the protective effect of high muscle mass against ischemic stroke[9]. The association between cardiovascular events and sarcopenia is well recognized; thus, regaining muscle strength in stroke survivors may improve cardiovascular health by increasing daily activity. Isokinetic dynamometers, frequently used to improve muscle strength for rehabilitation purposes, have very low complications due to overloading, making these devices a valuable alternative for post-stroke hemiplegia patients. Such a therapeutic approach may improve quality of life and support patients in returning to their daily routines.

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