CASE REPORT

Three cases of disuse syndrome patients who improved by KAATSU training®

I. Satoh

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[Objective] To determine the effects of KAATSU training on disuse syndrome.
[Methods] A 6- to 12-minute KAATSU training session consisting of three different motions was implemented in 3 patients using a KAATSU training instrument manufactured by Sato Sports Plaza Co., Ltd. twice weekly for 2 to 4 months. Muscle mass, muscular strength, and physical performance were evaluated using a bioelectrical impedance analyzer, a grip dynamometer, and the Timed UP and Go test (TUG test), respectively, before and after KAATSU training. Growth hormone (GH) levels were measured in 2 patients.
[Results] After KAATSU training, muscle mass increased in all 3 patients, by 12%, 4.5%, and 3.3%, respectively; grip strength also increased in all 3 patients by 6%, 50%, and 8.3%, respectively. Although TUG time shortened in 1 patient, TUG test was discontinued in the other 2 patients because of knee pain or a fall during measurement. The GH levels rose 5 and 10 fold in the 2 patients measured, compared with the levels obtained before KAATSU training.
[Conclusion] KAATSU training ensures early muscle strengthening, and is expected to be valuable for the prevention and treatment of not only disuse syndrome, but also sarcopenia.

Correspondence to:
I. Satoh, Satoh Clinic
1-4-25, Tokiwacho, Ube,
Yamaguchi, 755-0031 Japan
isatoh@gb3.so-net.ne.jp

See end of article for
authors' affiliations

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1. INTRODUCTION

KAATSU training[1] is reportedly effective in a broad range of fields, including muscle building and strengthening[2], health promotion, and aesthetic improvement, as well as medical care such as for the prevention and treatment of metabolic syndrome, locomotive syndrome, and sarcopenia. In addition, the earlier onset of effect compared to the typically used methods of muscle training[3,4] is advantageous for disuse syndrome, which must be detected and treated as early after onset as possible. In a previous study, this method was applied to 51 patients with lifestyle-related disease at our clinic, and therapeutic effects were obtained in 31 patients (61%), including blood pressure reductions, blood glucose level reductions, and lipid level reductions[5], with increased muscle mass observed in most patients. Taking into consideration these findings, the present study was conducted to determine the effects of KAATSU training on disuse syndrome.

2. SUBJECTS

The subjects of this study were 3 patients with disuse syndrome of different etiologies.

Case 1: A 77-year-old male

[Diagnosed disease] Disuse syndrome
[Complications] Hypertension and cerebral infarction sequelae
[History of present illness] The patient had essentially a lifestyle with low physical activity. Following the Great Eastern Japan Earthquake of March 11, 2011, he continued to have decreased physical activity in his daily life due to evacuation to a remote place, a long hotel stay, and other factors. As a result, he became unable to walk without a cane. After 7 months of evacuation, he was unable to get out of the hotel bathtub by himself, necessitating emergent care by a physician. With the diagnosis of disuse syndrome due to muscular strength reduction, the patient was encouraged to begin KAATSU training.
[Vital signs] Height: 168 cm, weight: 70 kg, blood pressure: 122/82 mmHg, abdominal circumference: 96 cm

Case 2: An 84-year-old female

[Diagnosed disease] Disuse syndrome
[Complications] Cerebral infarction sequelae, left hemiparesis, and angina pectoris
[History of present illness] The patient had suffered cerebral infarction 10 years previously. With left hemiparesis, she attended a nearby clinic by walking there with a cane. She used to have radio calisthenics every day. One day, chest pain occurred during exercise; she visited our clinic, and was diagnosed with angina pectoris. Although the chest pain

disappeared with administration of an anti-anginal drug, her family requested KAATSU training for her after seeing its application on another patient. With the diagnosis of disuse syndrome resulting from decreased activity due to cerebral infarction and left hemiparesis, KAATSU training was begun.

[Vital signs] Height: 143 cm, weight: 45 kg, blood pressure: 126/76 mmHg

Case 3: A 44-year-old female

[Diagnosed disease] Disuse syndrome

[Complications] Systemic lupus erythematosus

[History of present illness] Three years previously, the patient experienced systemic pain and muscular strength reduction such that she was unable to get up without assistance. She visited a few medical institutions, and was diagnosed with collagen disease. Although medication mitigated the pain, her physical activity decreased by half compared with the pre-onset level. In this situation, along with newly developing anorexia, the essentially lightweight patient further lost 6 kg of weight, and had such pain that she was unable to sleep without wearing a towel around her waist. She was advised by her attending physician to gain weight, and to increase muscle strength, and was referred to our clinic. With the diagnosis of disuse syndrome resulting from decreased activity due to collagen disease, KAATSU training was begun.

[Vital signs] Height: 163 cm, weight: 37 kg, blood pressure: 94/62 mmHg

3. METHODS

After obtaining informed consent from each patient, KAATSU training was performed and measurements were taken. Specifically, 10 minutes of whole body stretching was followed by KAATSU training with a specially designed belt for KAATSU training (manufactured by Sato Sports Plaza Co., Ltd.) wrapped around the base of each upper arm or each leg. An appropriate pressure (60-120 mmHg on the upper arms, and 80-170 mmHg on the legs) was applied using a pneumatic KAATSU training instrument (KAATSU MASTER mini, manufactured by Sato Sports Plaza Co., Ltd.). This training took place twice weekly for 2 to 4 months. Each session consisted of the three specified motions[6]: 1) concurrent manual opening/closing of bilateral fingers and toes, 2) arm curls with concurrent elevation of both toes, and 3) back twists (pushdowns) of both upper limbs with concurrent elevation of both heels (calf raises). This set of motions was repeated 30 times at short intervals of 20 seconds for a total of 12 minutes. The effects were assessed in terms of weight, muscle mass, and fat mass measured using a body composition scale (MC-190, manufactured by TANITA Corporation), as well as muscular strength measured using a grip dynamometer. In the TUG test, time for a reciprocal walk between the starting point and the goal point (2 m apart) was measured. GH levels were measured in 2 cases. To ensure the accurate determination of the effects of KAATSU training, each patient was instructed not to change his or her lifestyle habits such as diet, exercise, and drug intake. In case 2 with angina pectoris, caution was exercised to avoid an excessive increase of burden on the heart from KAATSU training. Specifically, KAATSU training was started 5 days after symptoms disappeared with anti-anginal medication administration. While the patient remained in sitting position, the pressurizing belt was wrapped around the base of each leg. With initial pressure set at 120 mmHg on the left affected side, and 80 mmHg on the right unaffected side, blood pressure and pulse rate were measured every 3 minutes during the training session, while preventing the blood pressure and pulse rate from increasing by more than 10 mmHg and 10 beats/min, respectively.

4. RESULTS

Case 1

After 3 months of KAATSU training, this patient's muscle mass was markedly increased by 5.15 kg, fat mass conversely decreased by 2.7 kg, and grip strength increased by 1.5 kg (Table 1). Although the TUG test was discontinued because of a fall during measurement after 3 months of KAATSU training, the lower limb muscle mass increased by 1.6 kg, and his walking speed increased dramatically, with an increased pace, compared with the level obtained prior to the start of KAATSU training.

Immediately after the earthquake disaster, this patient was forced to emergently evacuate from his home, leaving behind his possessions, including work materials; he was a writer by profession. From the day of the disaster, he unavoidably had a long hotel stay at a remote location, resulting in hypobulia, depression, memory deterioration, and other problems. While he had been unreceptive to the idea of receiving KAATSU training, his daughter, who had experience with the use of this method, visited him and encouraged him to receive the training. Since that time, the patient has been able to continue KAATSU training with no interruption for 3 months, resulting in remarkable recovery of muscle mass and muscular strength. According to his family, the patient became able to walk without a cane, and was again motivated to do his work. However, it was impossible to obtain an objective assessment because mood profiling tests, such as POMS, were not conducted.

Case 2

This is a rare case in which the patient achieved improvements in all parameters examined after 4 months of continued KAATSU training implemented twice weekly with the attendance of her family

Table 1. A 77-year-old man; height 168 cm

Parameter (unit of measurement)	Standard value	Before KAATSU training	After 3 months of KAATSU training	Absolute change	Percent change (%)
Weight (kg)	62.1	70.2	72.9↑	+2.7	+3.9
Muscle mass (kg)	47.1	**43.5**	**48.7↑↑**	**+5.2**	**+12.0**
Lower limb muscle mass (kg)		17.0	18.6↑	+1.6	+9.4
Fat mass (kg)	12.4	**24.3**	**21.6↓**	**-2.7**	**-10.0**
Visceral fat level*	≤9	**18**	**18-**	0	0
Estimated bone mass (kg)	2.9	**2.40**	**2.70↑**	+0.30	**+17.4**
Right grip strength (kg)	35.5	25.0	26.5↑	+1.5	+6.0
2-Meter TUG (sec)		15 (with cane)	Fall (without cane)	—	—

*Visceral fat level 10 = CT 100 cm^2

Table 2. An 84-year-old woman; height 143 cm

Parameter (unit of measurement)	Standard value	Before KAATSU training	After 4 months of KAATSU training	Absolute change	Percent change (%)
Body weight (kg)	45.0	45.0	45.3↑	+0.3	+0.6
Muscle mass (kg)	29.9	30.9	**32.3↑**	**+1.4**	**+4.5**
Right lower limb muscle mass (kg)		4.65	5.05↑	+0.4	+8.6
Left lower limb muscle mass (kg)		4.55	4.95↑	+0.4	+8.8
Fat mass (kg)	13.5	12.4	**11.2↓**	**-1.2**	**- 9.7**
Visceral fat level	≤9	7	**6↓**	**-1**	**-14.3**
Estimated bone mass (kg)	1.8	1.70	**1.85↑**	**+0.15**	**+8.8**
Left grip strength (kg)	14.1	10	**15↑**	**+ 5**	**+50.0**
Growth hormone level (ng/ml)	≤0.42	0.24	**2.57↑**	**+2.33**	**+1,071.0**
2-Meter TUG (sec)		10.0	9.0↓	-1.0	-10.0

(Table 2). Although the pressure setting was carefully and gradually increased to 170 mmHg for the right leg, and 130 mmHg for the left leg, no angina pectoris attack occurred during KAATSU training.

This patient said that she felt refreshed after finishing a KAATSU training session. One month after the start of KAATSU training, she sometimes looked cheerful prior to onset of cerebral infarction, suggesting a mental amelioration. At 88 years of age, 4 years after the start of the training, she was hospitalized for pneumonia and discontinued the training. After hospital discharge, familial reasons made it impossible for the patient to make twice-a-week visits; KAATSU training was unavoidably discontinued. However, despite various conditions that are otherwise likely to cause disuse syndrome, such as pneumonia, hospital stay, and bed rest, her muscle mass was determined to be 29.7 kg at 4 months after discontinuation of KAATSU training, which was 0.7 kg heavier than the standard muscle mass for her age (29.0 kg), suggesting sustained effect of KAATSU training.

Case 3

Continued weight loss ceased after 2 weeks of KAATSU training, and a 1 kg gain was achieved after 2 months of KAATSU training. This small gain was a result of increases in muscle mass and estimated bone mass. Of note was a further reduction in her fat mass, which had been too low for her age and physique. (Table 3)

In this patient, KAATSU training resulted in a mitigation of joint pain, a slight gain of weight, which had been decreasing despite various treatments, and an increase in grip strength. With these and other effects recognized, the patient wished to continue KAATSU training at home, and purchased a KAATSU

Table 3. A 44-year-old woman; height 163 cm

Parameter (unit of measurement)	Standard value	Before KAATSU training	After 2 months of KAATSU training	Absolute change	Percent change (%)
Body weight (kg)	58.5	**38.65**	**39.60↑**	+1.0	+2.4
Muscle mass (kg)	39.1	30.3	**31.3↑**	**+1.0**	**+3.3**
Lower limb muscle mass (kg)		10.25	11.15↑	+0.4	+8.9
Fat mass (kg)	17.0	**6.7**	**6.5↓**	**-0.2**	**-3.0**
Visceral fat level	≤9	1	**1-**	0	0
Estimated bone mass (kg)	2.2	1.65	1.75↑	+0.1	+6.1
Right grip strength (kg)	29.9	24.0↓	26.0↑	+ 2.0	+8.3
Growth hormone level (ng/mL)	0.28-2.64	1.01	**5.54↑**	**+5.5**	**+549.0**
2-Meter TUG (sec)		6.0	—	—	—

training instrument (KAATSU MASTER mini). She is currently continuing to implement this method at home.

5. DISCUSSION

Disuse syndrome[7] is a syndrome characterized by muscle volume reduction and other physical and mental functional impairments due to physical inactivity[8]. The primary causes of disuse syndrome include bed-ridden state and bed rest; however, rare cases are caused by other causes such as living in a zero-gravity environment, living in disaster evacuation status, and physical inactivity due to pain/paralysis. One study dealt with disuse syndrome in the category of secondary sarcopenia (muscle mass reduction due to aging)[9]. Because our institution is a non-bed clinic, all visitors are ambulatory outpatients; therefore, we rarely encounter disuse syndrome, which often arises from hospitalization. While sarcopenia is extremely difficult to cure to complete recovery, disuse syndrome is expected to be curable by eliminating the cause(s) of activity limitations and/or activating the patient's physical activity. For this reason, both the trainer and the patient can share a hope for recovery, so that medical care is rarely discontinued prematurely. In all 3 of the present cases, disuse syndrome occurred due to respective physical activity limitations: a stay in the limited space of a hotel in Case 1, mobility limitations due to left hemiparesis following cerebral infarction in Case 2, and disturbance of daily activity due to severe systemic pain in Case 3. These 3 patients were given an explanation that recovery from their disuse syndrome would be possible by muscular pressurization, and they consented to receive KAATSU training. This situation appeared to have motivated them to continue KAATSU training, despite their anxiety about the unfamiliar method of training, and also it led to the onset of the observed effects. Muscle mass was measured using the TANITA MC-190 body composition scale, an 8-electrode segmental bioelectrical impedance analysis (S-BIA method), and an improved version of conventional bioelectrical impedance analysis (BIA method). This approach made it possible to evaluate the body composition of each patient in various parts of his or her body. The muscle mass measurements were analyzable with an accuracy equivalent to that of dual-energy X-ray absorptiometry (DXA method)[10], although the values thus obtained were slightly lower than those obtained with the MRI method. Hence, an increase in muscle mass was confirmed at various parts of the body in all cases examined. Regarding the effect onset mechanism (increased muscle mass and decreased fat mass), the growth hormone level rose 5 and 10 fold in 2 cases after 30 minutes of KAATSU training, suggesting the involvement of bioactive substances such as GH and IGF-1 in the onset, as reported by Sato[1], Takarada et al.[2], and Abe et al.[3]. While one study reports that KAATSU training reduces the bone resorption marker (NTx)[11], further research will be necessary to explain the mechanism behind the increase in the estimated bone mass in all cases. Although a psychological effect was suggested, no appropriate test was available at our facility to evaluate psychological effects; it will be necessary to conduct further investigation.

6. CONCLUSION

KAATSU training quickly achieved remarkable improvements in muscle mass, muscular strength, and physical performance in 3 patients with disuse syndrome. This fact suggests that KAATSU training can be useful for muscular strengthening even in sarcopenia in a super-aging society. Furthermore, in the field of preventive medicine as well, this method is expected to play a major role in the medical care for metabolic syndrome and locomotive syndrome, and

have a considerable impact on medical care cost reduction[12].

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A part of this study was included in the oral presentation entitled, "Prevention of Sarcopenia at Our Clinic—With a Focus on KAATSU Training" (in Japanese) at the 15th Annual Conference of the Japan Kaatsu Training Society at Okayama on October 14, 2012.

Authors' affiliation
Ikuo Satoh, Satoh Clinic