

Раздел 2

МЕДИКО-БИОЛОГИЧЕСКИЕ ВОПРОСЫ ЗДОРОВЬЯ ЧЕЛОВЕКА

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EFFECT OF REPETITIVE FACILITATIVE EXERCISE (RFE) ON THE RECOVERY OF UPPER LIMB FUNCTION IN STROKE PATIENTS WITH HEMIPLEGIA

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ВЛИЯНИЕ ПОВТОРЯЮЩИХСЯ ВСПОМОГАТЕЛЬНЫХ УПРАЖНЕНИЙ (RFE) НА ВОССТАНОВЛЕНИЕ ФУНКЦИИ ВЕРХНИХ КОНЕЧНОСТЕЙ У БОЛЬНЫХ С ИНСУЛЬТОМ И ГЕМИПЛЕГИЕЙ

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Abstract. Kawahira method is a new approach to post-stroke hemiplegia developed by Dr. Kazumi Kawahira. The Kawahira method uses the extension reflex and the skin muscle reflex to trigger muscle contraction, excite and strengthen specific nerve conduction pathways, therefore, Kawahira method is also called Repetitive Facilitative Exercise (RFE).

Kawahira method promotes brain cells to perform motor learning through special facilitation of hand skills and neural reflexes, as well as electrical stimulation and other auxiliary methods. Kawahira method may be more effective than conventional rehabilitation in lessening impairment and improving upper-limb motor function during the subacute phase of stroke.

Keywords: Kawahira method, repetitive facilitative exercise (RFE), stroke, rehabilitation medicine

Аннотация. В статье представлены исследования по методу Кавахира. Метод Кавахира — это новый подход к лечению постинсультной гемиплегии, разработанный доктором Кадзуми Кавахира. Метод Кавахира использует рефлекс разгибания и рефлекс кожных мышц для запуска сокращения мышц, возбуждения и усиления определенных проводящих путей нервов, поэтому метод Кавахира также называется повторяющимися вспомогательными упражнениями (RFE).

Метод Кавахира стимулирует клетки мозга выполнять двигательное обучение за счет особого облегчения навыков рук и нервных рефлексов, а также электрической стимуляции и других вспомогательных методов. Метод Кавахира может быть более эффективным, чем обычная реабилитация, в уменьшении нарушений и улучшении двигательной функции верхних конечностей во время подострой фазы инсульта.

Ключевые слова: метод Кавахира, повторяющиеся фасилитативные упражнения (RFE), инсульт, восстановление

Repetitive facilitative exercise (RFE) is a new approach to post-stroke hemiplegia developed by Dr. Kazumi Kawahira, therefore, RFE is also called Kawahira method, whose effect has proved to be particularly notable in the improvement of upper limb function. This is the recommended treatment in the “Stroke Treatment Guidelines 2015” by Japan Stroke Association (Ogawa Akira et al., 2015). Currently,

the Kawahira method is widely used in Japan and China for rehabilitation of stroke patients.

The theoretical basis of Kawahira method

The mechanism by which the movement of the limbs paralyzed by the Kawahira method is improved is that the function lost in the brain is newly learned and repeated learning leads to the acquisition. In the process of rehabilitation training, Kawahira method promotes brain

cells to perform motor learning through special facilitation of hand skills and neural reflexes, as well as electrical stimulation and other auxiliary methods.

The Kawahira method uses the extension reflex and the skin muscle reflex to trigger muscle contraction, excite and strengthen specific nerve conduction pathways. In order to improve the efficiency of specific conduction pathways, the same exercise training mode is repeated, starting from the proximal limbs with good voluntary movement, and gradually expanding to the distal limbs, giving priority to exercise training closely related to daily life Repeat learning to strengthen neural circuits, by moving the limbs, the brain learns, but by repeating the same movements over and over again, the learning becomes stronger (Kawahira K. et al., 2010).

The technique and rehabilitation effect of Kawahira method

In patients with severe hemiplegia, the motor function of the proximal limbs is better than that of the fingers. For example, the voluntary motor function of the shoulder is better than that of the fingers. Relying on the movement of the shoulders to drive the voluntary movement of the elbows and fingers, it can have a joint effect.

Therefore, when performing finger function training, the shoulder function must first be

improved. For patients with severe hemiplegia, you can also repeatedly rub and tap the skin on the back of the forearm, as shown in **Figure 1**, making full use of the skin muscle reflex to induce wrist muscle contraction.



Fig 1. Rub and tap the skin on the back of the forearm

When performing finger facilitation training, ask patients to annotate their fingers and cooperate with the therapist's training to strive to achieve the exercise intention. As shown in **Figure 2**, in order to achieve a single extension of the index finger, let the patient look at his finger, flex the index finger in advance, and then ask the patient: "Please stretch out the finger", and then a single extension of the index finger will appear.



The fingers are preflexed



Patient extend the finger

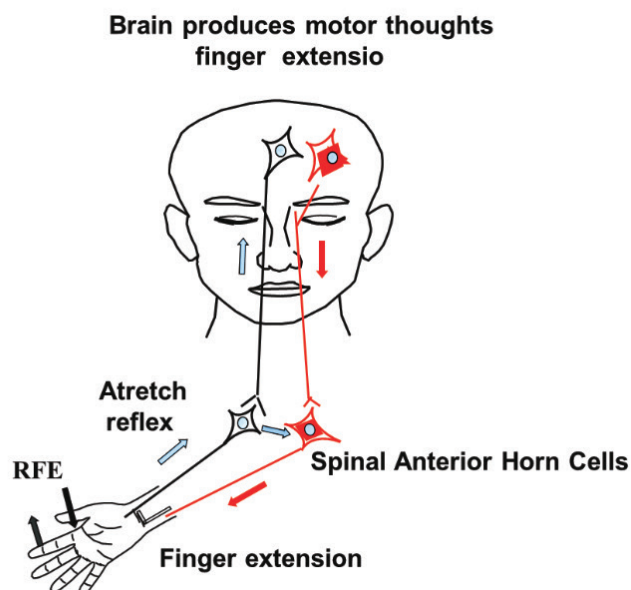


Fig 2. Kawahira method for finger function recovery training

This is because after the index finger is flexed in advance, an extension reflex is generated, and the excitability of the nerve conduction pathway that transmits the signal of the finger is increased. When performing finger training, no matter which finger joint, each time you perform flexion and extension training, the number of times must reach more than 100 times, so as to achieve the purpose of promoting and strengthening the conduction pathway (Kawahira Kazumi et al., 2021).

The effect of Kawahira method has been confirmed by clinical studies, as shown in **Figure 3**, the changes of FMA and ARAT in REF group were significantly greater than those in control group. these findings suggest that RFE may be more effective than conventional rehabilitation in lessening impairment and improving upper-limb motor function during the subacute phase of stroke (Shimodozono M. et al., 2013).

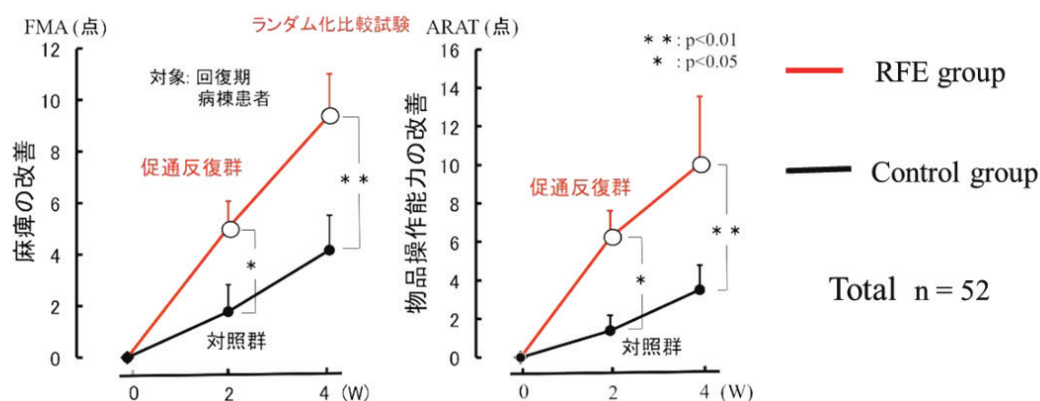


Fig 3. RFE significantly altered FMA and ARAT in stroke patients

Effect of Kawahira method combined with continuous low-frequency electrical stimulation on Upper-limb Motor Impairment and Hand Edema during an Acute Phase of Cerebral Infarction.

low-frequency electrical stimulation therapy is to use low-frequency current (frequency <100Hz) to stimulate nerves and muscles, cause muscle contraction to restore neuromuscular function,

and improve the nerve excitability and conduction function of the limbs of patients with hemiplegia.

As shown in **Figure 4**, a low-frequency pulse electrical stimulation therapy instrument (ITO Trio300) was used to stimulate the radial extensor muscle of wrist, with a pulse frequency of 20 Hz and a pulse width of 250 ms, the current intensity was set to a threshold level that could cause weak muscle contraction.

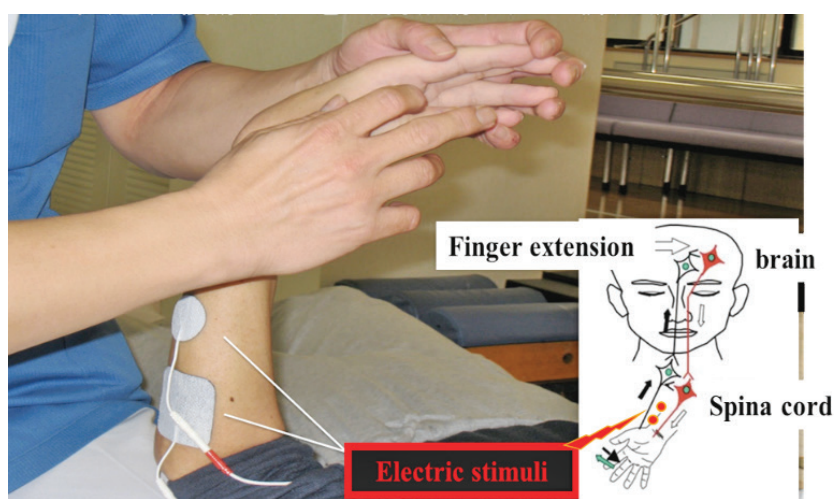


Fig 4. RFE concurrent with low-frequency electrical stimulation

The low-frequency pulse current is input into the upper limb muscles through the skin, which increases neuromuscular sensitivity, inhibits muscle spasm, and reduces joint pain. On this basis, repeated facilitation training of the upper limbs and fingers are carried out at the same time, whether it is the active movement of a single finger or the passive movement, it becomes easy to induce.

Repetitive facilitation exercise concurrent with continuous low-frequency electrical stimulation therapy is effective not only for recovery from motor impairment but also for reducing swelling of the hand during the acute phase of cerebral infarction (Atsushi Maesako et, al., 2014).

The influence of Kawahira method on blood flow of brain tissue in patients with hemiplegia.

When the finger moves, the cerebral blood flow will change, which can be observed with near-infrared spectroscopy (NIRS) (Yamada Minoru,

et al., 2008). Implement Repetitive Facilitation Exercise for patients with hemiplegia, perform forearm pronation moves and supination moves, exercise for 10 minutes at a rhythm of once every 2 seconds, and then use near-infrared spectroscopy (NIRS) to measure the changes in cerebral blood flow. On this basis, the forearm exercise training lasted for 4 weeks, and the cerebral blood flow was measured again.

As shown in **Figure 5**, before performing the Repetitive Facilitation Exercise, the blood flow of the brain tissue has a wide range of changes during the forearm exercise. To complete the forearm exercise, the entire brain tissue needs to be *enliven*; and after the Repetitive Facilitation Exercise is performed, only a few blood flow of the brain tissue of the part increases. At this time, to complete the forearm movement, It only needs the brain tissues of the corresponding parts to become active and stimulate specific nerve conduction pathways to realize the movement intention.

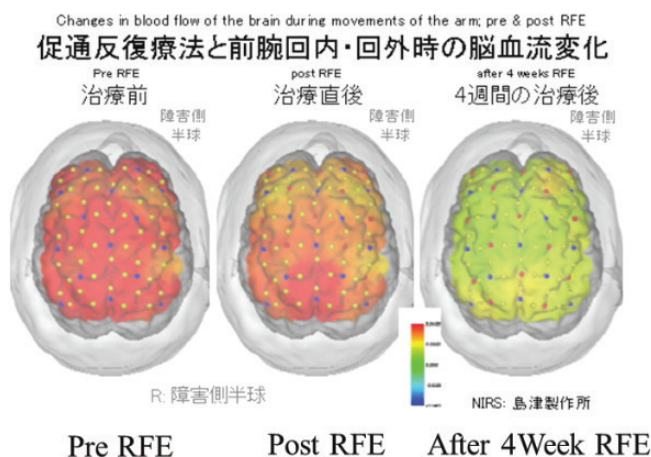


Fig 5. Changes in blood flow of the brain during movements of the arm

Application and promotion of Kawahira method in Japan and in China

The Kawahira method adds an important dimension to rehabilitation. Use of the method provides stimulation to the upper limbs to assist in stroke rehabilitation. There are more than 20 hospitals in Japan as designated hospitals for the

Kawahira method, and the Kawahira method is applicable to health insurance in Japan. Kawahira method promotion centers have been established in two cities in China, In the future, Kawahira method will be further popularized and used to serve strok patients with hemiplegia (Institute of Repetitive Facilitative Exercise. 2021).

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