The application of functional electrical stimulation (FES) in occupational therapy for the rehabilitation of upper limb function of patients with stroke: A preliminary study


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**Abstract**

**Objective:** To examine the effectiveness of the application of functional electrical stimulation (FES) in occupational therapy for the rehabilitation of upper limb function of patients with stroke.

**Design:** Three chronic stroke patients who had no active finger release (at least 1 year after on-set of stroke).

Subjects underwent FES training with tasks during occupational therapy on their extensor digitorium superficialis and abductor pollicis longus muscles twice or three times a week for a total 15 sessions. Seven clinical tests were examined before and after the training.

**Results:** Functional Test for the hemiplegic upper extremity, the grip power and Fugl-Meyer Assessment and three other clinical tests showed improvement in all patients.

**Conclusion:** The combination therapy (FES and occupational therapy training) is a potential effective training for patients after stroke.

**1 Introduction**

One of the biggest problems is the impairment of the upper limb function. According to the survey of the people with stroke on their upper limb function, upper limb recovery after stroke is unacceptably poor with only 50% of stroke survivors likely to regain some functional use (Broeks et al., 1999) compared with 82% who could expect to walk independently again (Kwakkel et al., 1999).

From the literature review, we notice that self initiated FES (De Kroon et al., 2005) and using of the task related training (Theilman et al., 2004) involving bilateral hands (Rose and Winstein, 2005) are effective elements for the upper limb rehabilitation of the people with stroke. Thus, in this preliminary study, we would incorporate the functional electrical stimulation into conventional occupational therapy (hand function) training toward the rehabilitation of the upper limb functions of the people with stroke and measure the treatment effectiveness.

**2 Methods**

This preliminary study recruited three chronic stroke (after 1 year of on-set of stroke) out-patients of the Occupational Therapy Department in the Kowloon Hospital. Repeated measurements will be done at day 0 (date for initial assessment) and day 15 (end of treatment). The Assessments included Functional Test for the hemiplegic upper extremity (Hong Kong Version), the Functional Independence Measurement score, the grip power of the affected hand, Fugl-Meyer Assessment of motor function of the upper extremity in hemiplegia, the measurement of forward reaching distance and questionnaire. Those assessments would be done by a blinded assessor. The number of repetitions of the training tasks within fixed time for the subjects with and without FES had been recorded throughout the treatment period. The subjects attended 15 sessions of training and each session duration was 1.5 hrs. The training protocol included passive mobilization, FES and activity based training, and the conventional occupational therapy treatment.

The portable FES device provided stimulation to the affected hand to facilitate them to perform release and participate into daily activities. The stimulation unit is self triggered by the motion of the patients’ unaffected hand. The stimulation electrode placed on the motor point of the extensor
digitortium superficiais and abductor pollicis longus muscles.

The FES unit, training protocol and the training activities are listed as below.

**Figure 1. The FES unit**

**Intervention Group**
- 10 minutes stretching/passive mobilization activities
- 20 minutes Functional Electrical Stimulation and activity based training
- 60 minutes conventional occupational therapy training

**Figure 2. The training protocol of the preliminary study**

**Figure 3. The training activities with FES and activities during occupational therapy- spoon feeding and moving the bowl**

### 3 Results

All three subjects showed significant improvement in the Functional Test for the hemiplegic upper extremity, the grip power and Fugl-Meyer Assessment of motor function of the upper extremity in hemiplegia. Also, the forward reaching distance increased after the training. Besides all the subjects reported self-perceived improvement in the motor control of the upper limb and they used the affected hand in daily activities more frequently in the questionnaire. Moreover, the number of repetitions of the training tasks within 1 minute for the subjects with FES showed improving trend throughout the treatment period.

### 4 Discussion and Conclusions

The application of functional electrical stimulation (FES) in occupational therapy was a potential training for the rehabilitation of upper limb function of stroke patient. The self trigger mechanism by the subjects had an important role in active the stimulation during the daily activity tasks. Since the result of the preliminary study is encouraging, a larger scale randomized control trial will be conducted to investigate the effectiveness.

### References


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