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# PROCEEDINGS BOOK

PAPER

# HAND REHABILITATION: I – ARTIFICIAL MOVEMENT RESTORATION

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## Introduction

Upper limb functions are grasping and manipulating objects. In patients with spinal cord injuries at cervical levels, communication between supraspinal centers and muscles below the level of lesion is often completely absent, resulting in severe paralysis of the upper extremities and definitely loss of independence.

## Material and methods

Neuromuscular electrical stimulation has been used in upper limb rehabilitation towards restoring motor hand function.
An open-loop microcontroled system with fixed stimulation parameters and surface electrodes were used. Muscle activation sequences were defined. Palmar and lateral grasps were used to hold objects encountered in daily living.
Power grip – index finger extension type was used as non-prehensive movement suitable to typewriting activity.

## Results

The subjects were able to achieve good grasp performance in all grasp patterns studied in this program. The sequences used in this work allowed subjects to demonstrate their ability to hold and release the objects that are encountered in daily living such as a glass, a pen and cutlery. Object manipulation could be achieved by voluntary control of shoulder and elbow, permitting activities such as drinking, eating, writing and typewriting.

Figure 1 - Daily living activities

## Conclusions

This work has shown that it is possible to obtain a functional grasp in spite of open-loop fixed stimulation parameter system and surface electrodes. However, for practical daily use implanted electrodes and a closed-loop system with force modulation control should be chosen.

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