

FES and Fun

Abstract

Functional electrical stimulation (FES) is a well established method for patients with different neuromuscular diseases. Since the technical development advanced FES is used in clinical as well as in domestic setting. FES as a therapeutic intervention might be burdensome in daily routine. To increase the motivation and support this method with a fun factor it can be combined with video games, board games or sport activities like cycling.

Introduction

Functional electrical stimulation (FES) is applied on different neuromuscular diseases, e.g. after stroke (1,2), spinal cord injury (SCI)(3,4) and cerebral palsy (CP). FES is predominantly used therapeutically for improving function on the impairment (i.e., structural) level, as a neural orthosis during activity and to a lesser degree, for participation in the community. FES is a well-established modality and primarily used clinically, however, recently developed commercially available foot drop (5,6) and hand function systems (7,8) have made at-home use of FES possible and more widely accepted. As a result, at-home FES use for functional use had increased and alternate uses therapeutic exercise and participation in the community setting are emerging. Because FES use can be “boring” and tedious in the rehabilitation setting, making FES fun is a potentially strong driving factor to increase “dose” and facilitate the motor learning process. That is, if FES use is fun, therapy becomes transparent and may no longer be deemed boring or burdensome. Motivational effects of game play can be used in the rehabilitation setting to increase the engagement of the patients during therapy. There is some evidence that video games are beneficial for the motor learning process on skill and cognitive level (9)

The purpose of this article is be less scientific and present the “fun factor” of FES use through clinical cases of FES training of individuals with SCI and from experiences gained during a randomized clinical study on the use of FES-assisted cycling for individuals with CP. The examples will highlight how FES use can be motivating and supportive to rehabilitation goals.

Subjects and Methods

Case studies of six SCI patients, AIS D, that received either FES to improve function to muscles of the lower limbs, to the muscles of the trunk, or the upper limbs are described. For this case series, subjects first trained using FES, after classical physiotherapy, but during directed exercise. The subjects then transitioned to FES use during Wii (Table 1) and board game play. The patients used the Nintendo Wii U in combination with either the EMG-triggered stimulation of the Stiwel med4 from Otto Bock, Austria or the eight channel Stimulator Motionstim from Krauth&Timmermann, Germany. For the board game the game “ludo” was played. Grasping and moving the tiles were performed by FES, using the two channel stimulator Microstim with a switcher from Krauth&Timmermann, Germany. The treatment combination of FES and Wii was performed five times á week for 30 min. The board game was played three times á week for 45 min. (Table 2). All treatments were supported by a physio- or occupational therapist.

Table 1: Patients' characteristics, including stimulated muscles and performed game

| subject | lesion | AIS | age | gender | FES | game |
|---------|--------|-----|-----|--------|---|-------------|
| 1 | TH11 | D | 52 | m | M. triceps surae | ski jumping |
| 2 | C4 | D | 25 | m | Mm. abdominales | boxing |
| 3 | L3 | D | 35 | m | Mm. abdominales/Mm. Rhomboidei | rafting |
| 4 | C4 | D | 51 | m | M. deltoideus/Mm. addominales/ Mm. rhomboidei | tennis |

Abbreviations: AIS: Asia impairment scale, FES: functional electrical stimulation, TH: thoracic, C: cervical

Table2: Patients' characteristics, including stimulated function and performed game

| subject | lesion | AIS | age | gender | function | game |
|---------|--------|-----|-----|--------|----------|------|
| 1 | C6 | B | 45 | m | grasp | ludo |
| 2 | C4 | C | 33 | m | grasp | ludo |

Abbreviations: AIS: Asia impairment scale, C: cervical

Results

The average time whereas the 4 patients performed the FES in combination with the Wii was 2.75 weeks. The board game was played for four weeks, three times á week. No assessment was used regarding the functional outcome. Clinical observation showed improvements concerning the individual impairment and defined treatment goal. All patients were highly motivated to perform the "new" treatment. All six patients missed no session.

Discussion

Clinical observations and patients' feedback have illustrated that video game and board game animated FES could increase the motivation of patients during physio- and occupational therapy. Furthermore therapists reported that requested motor skill could be executed more easily by the combination of FES and video game based therapy than by FES during a required movement only. One could suppose that by increasing the motivation through the playful attraction the motor learning process is intensified (9). Due to the fact that these six case series were based on a clinical experiment if it would be possible to combine FES with the Wii, no further assessments were performed to measure a functional improvement. The patients' motivation was obviously higher than in traditional exercise based therapy. One major limitation was the lack of synchronisation between the systems. The stimulation cycle was difficult to modulate with the video game. A synchronised system would save time in installing the system. Playing board games was easier to perform, because an external switcher initiated the

stimulation. Here the limiting factor was the position and adhesion of the electrodes. By manipulating the tiles sometimes the electrodes lost contact or moved in in the palmar side of the hand due to sweating. For this the electrodes were fixed with tape. Tape was the only material that did not filled the palmar side of the hand. Other material like gloves hindered grasping.

Conclusion

Having fun during therapeutically tasks can increase the motivation and might help to improve the motor learning process. Furthermore it could help to transfer FES from the clinic into the daily life to follow treatment targets.

Literature

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