Use of the functional electrical stimulation (FES) bike in the post-operative rehabilitation of a child with cerebral palsy (CP)

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Objective

This case study highlights the feasibility and therapeutic utility of FES biking as a post-op rehab tool for youth with GMFCS III/IV level CP.

Introduction

What is FES?

FES or functional electrical stimulation produces a stimulus to the muscle during the execution of a functional task to elicit a contraction of that muscle.1

FES bike benefits

The RT300 FES bike is a medical device with the following FDA-approved indications:  
- relax muscle spasm  
- prevent or retard disuse atrophy  
- increase local blood circulation  
- maintain or increase range of motion

Why FES for CP population?

- risk of metabolic syndrome from inactivity2  
- provide fitness for persons with limited weight-bearing capacity3  
- improve gait pattern4  
- inpatient rehab length of stay

CP Evidence is LIMITED!

- 2/3 level 1 RCTs found improvements in ROM, strength (improvement) and sitting balance (activity)5  
- GMFCS II and III: mean speed and improved timing of muscle activation during gait4  
- GMFCS III–IV: well tolerated, immediate improvements in cycling performance6  
- Adult with CP cycling 3x/week for 12 weeks: 22% quadriceps strength, 17% fatigue (impairment), slightly improved Timed Up and Go Test (activity) and 17% independence with ADLs (participation)3

Goal

16 yr. old non-verbal male with spastic quadriplegic CP, GMFCS III, intellectual disability and autism. At age 11, he was a household ambulator and doing stairs. Over a 4 year period he underwent 4 surgeries including bilateral proximal femoral varus derotation and pelvic osteotomies, and hardware removals, leading to decline in function and mobility.

CASE STUDY

Rehab admission:

- Hardware removal (left hip)  
- Left tib. ant. and tib. post. lengthenings  
- Right Botox tib. post. and gastrosoleus  
- 2 weeks non weight-bearing

Most recent surgery leading to Acute Rehab admission:

- Standing pivot transfers (bed to wheelchair with hand-held assistance)  
- Walking from bedroom to bathroom in home with hand-held assistance

Pre-FES bike functioning

- Sit to stands max assist  
- Standing transfers max assist  
- Abnormal gait pattern (left foot dragging)  
- Body weight supported (Lite Gait) walking 50 feet  
- 10 mins activity tolerance

Post-FES bike functioning

- Sit to stands indep  
- Hand-held transfers  
- Reciprocal gait pattern (left foot swing through)  
- Hand-held walking 30 feet  
- 60 mins activity tolerance

Muscle groups targeted

- Quadriceps (35mA)  
- Gluteus (24mA)

Frequency: 35Hz  
Pulse width: 250us

Muscle Power: Initial = 1.3 m  
Final = 1.6 m

Patient Demographics:

- Motor: American 2  
- End - 85%

Intervention:

- Week 1: 2-bed exercises, sit at edge of bed  
- Week 3, 5: sit to stands and Lite Gait plus harness 5x/week  
- Week 4, 6-9: sit to stands, Lite Gait plus harness 2x/week + FES bike 15-35 mins, 3x/week

Bike-specific Gains

- 22% improvements in cycling performance  
- 3.3 miles walking from bedroom to bathroom in 3 weeks

Family Goals

1. Standing pivot transfers (bed to wheelchair with hand-held assistance)  
2. Walking from bedroom to bathroom in home with hand-held assistance  
3. Improved gait pattern

Outcome Measures

- Transfers max assist  
- Anterior view

Endurance: initial = 3.4 min  
Final = 5.8 min  
- Posterior view

- Muscle lengthening

Conclusion

FES biking proved to be a feasible and well tolerated rehab tool in a patient with severe physical and cognitive impairments, and communication challenges.

Next Steps

- Further high quality research is needed on FES biking as a post-operative rehab tool in children with CP  
- Research into the efficacy of FES as a cardiovascular exercise tool for people with CP is warranted

References

2. Restorative Therapies. www.restorative-therapies.com/uk/305ep

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