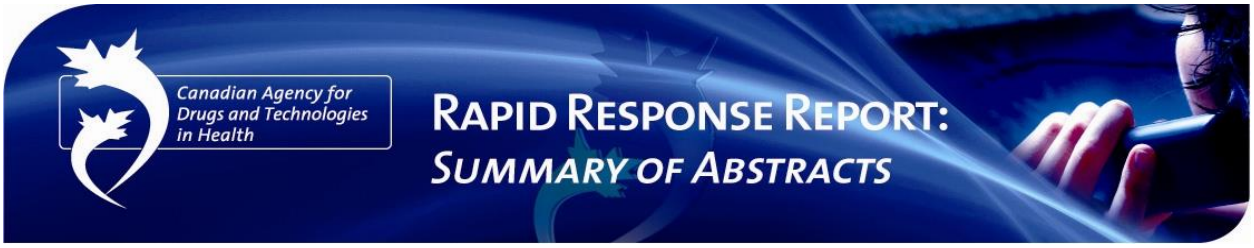

TITLE: Functional Electrical Stimulation for Children with Spinal Cord Injuries or Cerebral Palsy: Update of Review of Clinical Effectiveness

DATE: 6 August 2015

RESEARCH QUESTIONS

1. What is the clinical effectiveness of functional electrical stimulation (FES) including FES cycling (FES Cycle) for children with spinal cord injuries?

2. What is the clinical effectiveness of functional electrical stimulation (FES) including FES cycling (FES Cycle) for children with cerebral palsy?

KEY FINDINGS

Three systematic reviews, six randomized controlled trials, and six non-randomized studies were identified regarding the use of functional electrical stimulation (FES) for children with spinal cord injuries or cerebral palsy.

METHODS

A limited literature search was conducted on key resources including CINAHL, PubMed, The Cochrane Library, University of York Centre for Reviews and Dissemination (CRD) databases, Canadian and major international health technology agencies, as well as a focused Internet search. No filters were applied to limit the retrieval by study type. Where possible, retrieval was limited to the human population. The search was also limited to English language documents published between January 1, 2011 and July 23, 2015. Internet links were provided, where available.

The summary of findings was prepared from the abstracts of the relevant information. Please note that data contained in abstracts may not always be an accurate reflection of the data contained within the full article.

SELECTION CRITERIA

One reviewer screened citations and selected studies based on the inclusion criteria presented in Table 1.

Table 1: Selection Criteria

Population	Children with spinal cord injuries or cerebral palsy
Intervention	Functional electrical stimulation (FES); FES Cycle/Bikes
Comparator	No comparator; Any comparators
Outcomes	Clinical effectiveness (overall health [including functional mobility - walking, running, standing unassisted, Quality of Life]; any changes in health outcomes)
Study Designs	Health technology assessments, systematic reviews, meta-analyses, randomized controlled trials, non-randomized studies

RESULTS

Rapid Response reports are organized so that the higher quality evidence is presented first. Therefore, health technology assessment reports, systematic reviews, and meta-analyses are presented first. These are followed by randomized controlled trials and non-randomized studies.

Three systematic reviews, six randomized controlled trials, and six non-randomized studies were identified regarding the use of functional electrical stimulation (FES) for children with spinal cord injuries or cerebral palsy. No relevant health technology assessments were identified.

Additional references of potential interest are provided in the appendix.

OVERALL SUMMARY OF FINDINGS

Two systematic reviews[1-2] were identified regarding the use of FES for children with cerebral palsy. The 2015 systematic review[1] reported weak or conflicting evidence that FES improved postural control in children with cerebral palsy, while the systematic review by Chiu[2] reported that FES was more effective than no FES and had a similar effect as activity training alone for children with cerebral palsy. The third systematic review[3] reported FES to be a safe and moderately effective intervention to mitigate inactivity in youth with spinal cord injury.

Table 2 summarizes the findings of the randomized controlled trials[4-9] and non-randomized studies.[10-15] The majority of these studies reported on electrical stimulation interventions in children with cerebral palsy,[4-8,10,11,13-15] while two studies[9,12] reported on electrical stimulation interventions in children with spinal cord dysfunction. The majority of studies found FES to be an effective intervention and well tolerated by patients.

Table 2: Summary of Findings from the Randomized Controlled Trials and Non-Randomized Studies

First Author, Year	Population	Intervention	Comparator	Author Findings and Conclusions
Randomized Controlled Trials				
Pool, 2015[4]	N = 32 children with USCP	8 weeks of FES applied during every day walking	Usual therapy	FES improved self-perceived performance and satisfaction regarding functional skills
Yildizgoren, 2014[5]	N = 14 children with USCP	30 minute sessions (5 days a week for 6 weeks) of NMES with conventional exercise	Conventional exercise	NMES plus conventional exercise is effective at improving hand and wrist functions
Arya, 2012[6]	N = 10 children with spastic diplegic/hemiplegic CP	NMES plus conventional therapy (muscle strengthening exercises and physiotherapy)	Conventional therapy (muscle strengthening exercises and physiotherapy)	NMES plus conventional therapy is more effective than conventional therapy alone for improving walking ability and functional outcomes
Karabay, 2012[7]	N = 32 children with spastic diplegic CP	30 minute FES application (5 days a week for 4 weeks) to abdomen-posterior back muscles plus PTR	PTR program	FES plus PTR was more effective than PTR alone in improving balance when sitting
Xu, 2012[8]	N = 68 children with hemiplegic CP	ES plus constraint therapy for 2 weeks	Constraint therapy or occupational therapy	ES plus constraint therapy improved hand dysfunction more than two comparator interventions
Johnston, 2011[9]	N = 30 children with chronic SCI	FES cycling; or non-cycling, ES exercise	Passive cycling	FES cycling had the greatest improvement in muscle strength, ES had the greatest improvement in muscle volume
Non-Randomized Studies				
Pool, 2014[10]	N = 12 children with USCP	FES device for walking (daily for 8 weeks)	Pre-FES measurements	FES effectively reduced gait impairments for children with USCP

Table 2: Summary of Findings from the Randomized Controlled Trials and Non-Randomized Studies

First Author, Year	Population	Intervention	Comparator	Author Findings and Conclusions
Meilahn, 2013[11]	N = 10 children with hemiparetic CP	ES foot drop neuroprosthesis for 3 months	N/A	An ES foot drop neuroprosthesis was effective for treatment of foot drop and was well tolerated by children with hemiparetic CP
Castello, 2012[12]	N = 6 children and adolescents with spinal cord dysfunction	FES cycle	N/A	FES cycle improved BMD and quality of life, and improvement was associated with number of FES cycle sessions attended
Harrington, 2012[13]	N = 4 adolescents with spastic CP	FES cycle	Conventional cycling	FES cycle was well tolerated and improved cycling performance related outcomes
Prosser, 2012[14]	N = 21 children and adolescents with CP	FES device while walking (4 months)	Non-FES conditions	FES was effective for treatment of foot drop and improving mild gait impairments; the FES device was well accepted by participants
Alabdulwahab, 2011[15]	N = 17 children with spastic diplegic CP in the study group; N = 15 children with spastic diplegic CP in the control group; N = 17 healthy children in the second control group	ES of the bilateral hip adductor and abductor muscles during walking	Not specified	Gait performance, knee position, and muscle tone were improved in children receiving ES interventions

BMD = bone mineral density; CP = cerebral palsy; ES = electrical stimulation; FES = functional electrical stimulation; N/A = not applicable; NMES = neuromuscular electrical stimulation; PTR = physical therapy and rehabilitation; SCI = spinal cord injury; USCP = unilateral spastic cerebral palsy.

REFERENCES SUMMARIZED

Health Technology Assessments

No literature identified.

Systematic Reviews and Meta-analyses

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Randomized Controlled Trials

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APPENDIX – FURTHER INFORMATION:

Systematic Reviews – Uncertain Outcomes

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Randomized Controlled Trials

Alternate Outcomes

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Mixed Modality, Electric Stimulation with Botulinum Toxin

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