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Biofeedback Intervention for Children with Hemiplegic Cerebral Palsy¹

Clinical Question

- P** (population/problem): Among children ages 0 to 12 years diagnosed with hemiplegic cerebral palsy
- I** (intervention): does biofeedback (augmented feedback)
- C** (comparison) compared to usual care
- O** (outcome): improve function and/or decrease impairment?

Target Population: Children diagnosed with hemiplegic cerebral palsy, age 0 to 12 years of age

Inclusions:

- diagnosis of hemiplegic cerebral palsy and hemiparesis according to the DSM-IV² criteria and
- impairments in: strength, range of motion, balance, posture, body coordination, motor control, joint mobility, pain, muscle tone, functional independence and/or gross motor skill development

Exclusions:

- Children with significant cognitive delay who are unable to follow multi-step directions or to comply with recommendations.
- Children not ambulatory by age 3 years.

Recommendation

It is recommended that biofeedback be considered by a physical therapist as an adjunct to other forms of traditional physical therapy. Physical therapists may use surface electromyogram (EMG) biofeedback to facilitate improvements in strength, coordination, muscle control, and peak muscle power during gait as well as to improve gait parameters such as velocity, cadence and stride length (*Schleenbaker 1993 [1a], Dursun 2004 [2b], Bolek 2006 [4a], Bolek 2003 [4b], Toner 1998 [4b], Colborne 1994 [4b], James 1992 [5], Local Consensus [5]*).

Note: Studies generally included daily use of biofeedback with short varied duration periods of:

- 30 minutes per day for 10 days (*Dursun 2004 [2b]*),
- 30 minutes daily for 60 days (*Hartveld 1996 [5]*)
- and 45-60 minutes twice daily for 4 weeks (*Colborne 1994 [4b]*)
- to longer treatment periods of 5 hours each week for 6 weeks (*Toner 1998 [4b]*).

Discussion/summary of evidence

Studies of biofeedback (augmented feedback) provide evidence to suggest beneficial outcomes when using this modality as part of a comprehensive habilitation program for children diagnosed with hemiplegic cerebral palsy. Beneficial patient outcomes have been demonstrated in improved striated muscle control, strength, posture correction,

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² DSM-IV: Diagnostic and Statistical Manual of Mental Disorders, 4th Edition.

and gait training in children with cerebral palsy (Schleenbaker 1993 [1a], Dursun 2004 [2b], Bolek 2006 [4a], Colborne 1994 [4b], James 1992 [5]). There is no evidence regarding long-term benefits once the biofeedback intervention is stopped.

Two studies provide evidence that biofeedback improves dorsiflexion. This improvement was sustained at the post-training level for 14 months (Dursun 2004 [2b]) and 3 months (Toner 1998 [4b]) after the treatment period. Children with hemiplegic cerebral palsy (CP) receiving biofeedback and traditional physical therapy showed improved peak muscle power of plantar flexion and ankle dorsiflexion and decreased plantar flexion tone (Dursun 2004 [2b], Colborne 1994 [4b]). These gains were also maintained after the intervention's cessation. Children receiving biofeedback improved in all gait parameters with exception of cadence (Dursun 2004 [2b]).

Gains made during gait training in children diagnosed with hemiplegic cerebral palsy, including increased weight bearing on the heel and heel force of the hemiparetic leg, are clinically and statistically significant and demonstrate short-term carryover for one month following training (James 1992 [5]).

No evidence was found on the frequency, duration and need for "booster" sessions to maintain gains. Studies of the cost effectiveness of biofeedback may be warranted given expense of the equipment, the large number of treatments required and the specialized clinician training required.

References/citations

1. **Bolek, J. E.:** A preliminary study of modification of gait in real-time using surface electromyography. *Appl Psychophysiol Biofeedback*, 28(2): 129-38, 2003, [4b] _____
2. **Bolek, J. E.:** Use of multiple-site performance-contingent SEMG reward programming in pediatric rehabilitation: a retrospective review. *Appl Psychophysiol Biofeedback*, 31(3): 263-72, 2006, [4a] _____
3. **Colborne, G. R.; Wright, F. V.; and Naumann, S.:** Feedback of triceps surae EMG in gait of children with cerebral palsy: a controlled study. *Arch Phys Med Rehabil*, 75(1): 40-5, 1994, [4b] _____
4. **Dursun, E.; Dursun, N.; and Alican, D.:** Effects of biofeedback treatment on gait in children with cerebral palsy. *Disabil Rehabil*, 26(2): 116-20, 2004, [2b] _____
5. **Hartveld, A., and Hegarty, J.:** Frequent weightshift practice with computerised feedback by cerebral palsied children -- four single-case experiments. *Physiotherapy* 1996 Oct; 82(10):573-80 (22 ref), 1996, [5] _____
6. **James, R.:** Biofeedback treatment for cerebral palsy in children and adolescents: a review. *Pediatric Exercise Science* 1992 Aug; 4(3):198-212 (29 ref), 1992, [5] _____
7. **Local Consensus:** during the guideline development timeframe. ed., [5] _____
8. **Mannheimer, J., and Lampe, G.:** *Clinical transcutaneous electrical nerve stimulation*. 1984, [5] _____
9. **Schleenbaker, R. E., and Mainous, A. G., 3rd:** Electromyographic biofeedback for neuromuscular reeducation in the hemiplegic stroke patient: a meta-analysis. *Arch Phys Med Rehabil*, 74(12): 1301-4, 1993, [1a] _____
10. **Toner, L. V.; Cook, K.; and Elder, G. C.:** Improved ankle function in children with cerebral palsy after computer-assisted motor learning. *Dev Med Child Neurol*, 40(12): 829-35, 1998, [4b] _____

Note: Full tables of evidence grading system available in separate document:

- Table of Evidence Levels of Individual Studies by Domain, Study Design, & Quality (abbreviated table below)
<http://groups.ce/NewEBC/EBCFiles/Table-EvidenceLevels.pdf>
- Grading a Body of Evidence to Answer a Clinical Question
<http://groups.ce/NewEBC/EBCFiles/GradingBodyOfEvidence.pdf>
- Judging the Strength of a Recommendation (abbreviated table below)
<http://groups.ce/NewEBC/Judgingthestrengthofarecommendation.pdf>

Table of Evidence Levels (see note above)

<i>Quality level</i>	<i>Definition</i>
1a† or 1b†	Systematic review, meta-analysis, or meta-synthesis of multiple studies
2a or 2b	Best study design for domain
3a or 3b	Fair study design for domain
4a or 4b	Weak study design for domain
5	Other: General review, expert opinion, case report, consensus report, or guideline

†a = good quality study; b = lesser quality study

Table of Recommendation Strength (see note above)

<i>Strength</i>	<i>Definition</i>
“Strongly recommended”	There is consensus that benefits clearly outweigh risks and burdens (or visa-versa for negative recommendations).
“Recommended”	There is consensus that benefits are closely balanced with risks and burdens.
No recommendation made	There is lack of consensus to direct development of a recommendation.
<p><i>Dimensions:</i> In determining the strength of a recommendation, the development group makes a considered judgment in a consensus process that incorporates critically appraised evidence, clinical experience, and other dimensions as listed below.</p> <ol style="list-style-type: none"> Grade of the Body of Evidence (see note above) Safety / Harm Health benefit to patient (<i>direct benefit</i>) Burden to patient of adherence to recommendation (<i>cost, hassle, discomfort, pain, motivation, ability to adhere, time</i>) Cost-effectiveness to healthcare system (<i>balance of cost / savings of resources, staff time, and supplies based on published studies or onsite analysis</i>) Directness (<i>the extent to which the body of evidence directly answers the clinical question [population/problem, intervention, comparison, outcome]</i>) Impact on morbidity/mortality or quality of life 	

Supporting information

Introductory/background information

Biofeedback is an intervention designed to assist an individual in controlling a body-process output such as muscle activity. A body process is an organic process that takes place in the body. Biofeedback provides an individual with supplemental information about the response of a body-process of interest allowing the individual to attempt to control a given output associated with this process (i.e. muscle activity). Through trial and error the individual receives feedback on his or her success enabling a child with CP to adapt their behavior to achieve the desired output. There are a variety of instruments that are being used in research and in the clinical setting including surface EMG, computer-assisted feedback and a variety of simple auditory and visual feedback such as providing an auditory cue on the heel of a child to encourage heel-toe gait. When using surface EMG a slight skin reaction may occur at the electrode site (*Mannheimer 1984 [5]*).

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Search strategy

1. Databases

OVID MEDLINE,
OVID CINAHL

Search Terms: cerebral palsy, biofeedback, hemiplegia, children, physical therap\$, occupational therap\$

- 2. Limits and Filters:** English, humans; dates: January 1982 April 2008. This search was opened up to include those studies that also investigated biofeedback in adults with a hemiplegic stroke diagnosis.
- 3. Additional articles:** from reference lists

Known conflicts of interest:

Conflict of interest declarations were completed by members of the BESt development team and none were found.

Copies of this Best Evidence Statement (BESt) are available online and may be distributed by any organization for the global purpose of improving child health outcomes. Website address: <http://www.cincinnatichildrens.org/svc/alpha/h/health-policy/ev-based/default.htm>
Examples of approved uses of the BESt include the following:

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- the BESt may be adopted or adapted for use within the organization, provided that CCHMC receives appropriate attribution on all written or electronic documents; and
- copies may be provided to patients and the clinicians who manage their care.

Notification of CCHMC at HPCEInfo@cchmc.org for any BESt adopted, adapted, implemented or hyperlinked by the organization is appreciated.

*Additionally, for more information about CCHMC Best Evidence Statements and the development process, contact the **Division of Occupational Therapy and Physical Therapy** at: 513-636-4651 or OTPT@cchmc.org*

Note

This Best Evidence Statement addresses only key points of care for the target population; it is not intended to be a comprehensive practice guideline. These recommendations result from review of literature and practices current at the time of their formulation. This Best Evidence Statement does not preclude using care modalities proven efficacious in studies published subsequent to the current revision of this document. This document is not intended to impose standards of care preventing selective variances from the recommendations to meet the specific and unique requirements of individual patients. Adherence to this Statement is voluntary. The clinician in light of the individual circumstances presented by the patient must make the ultimate judgment regarding the priority of any specific procedure.

Reviewed by Clinical Effectiveness