

Effects of Cutaneous E-stim on UE Function in an Individual with Chronic CVA

Alex Deimling, Amanda Smith
and Zoe Walls

Faculty advisor: Dr. Nancy Fell

Outline of Events

- Spring/Summer 2007
 - Data collection
 - In cooperation with the Research Alliance of Chattanooga
 - Siskin Hospital
 - Chattanooga Group
 - UTC
- Fall 2007
 - IRB revision for follow up study

Literature Review

- NMES Literature
 - De Kroon, et al
 - Kimberly, et al
- Sensory Literature
 - Peurala, et al
 - Floel and Cohen
- SES/NMES Combo Literature
 - Sullivan and Hedman

Why a Case Series?

- Pilot Study
 - Smaller participant number
 - Unknown outcomes
- Convenient Participant Population
- Expense of Equipment
- Limited Clinician Resources

Hypothesis

- Sensory Electrical Stimulation will improve UE function of a person with chronic CVA.
 - Subjective ADL's improvement and quality of life
 - Objective motor and sensory improvement

Study Design

ORIGINAL PLANS

- ⊙ 5 participants
- ⊙ 9 months post CVA
- ⊙ Must meet all inclusion/exclusion criteria
- ⊙ Incentive of \$25 per visit to Siskin Hospital for treatments (total \$300)

ACTUAL EVENTS

- ⊙ 4 participants
 - 1 excluded at initial pre-test (received \$25)
 - 3 completed with full payment received
- ⊙ All other criteria remained unchanged

Methodology

- ⊙ Phone screening
- ⊙ Physician referral
- ⊙ Informed consent
- ⊙ Formal review of inclusion/exclusion criteria
- ⊙ Assessment of motor, sensory and functional abilities
- ⊙ Intervention
- ⊙ Re-assessment

INCLUSION CRITERIA

- Single cortical CVA at least 9 months ago
- Physician referral
- Decreased UE sensation and strength
- Limited functional use

EXCLUSION CRITERIA

- Inadequate skin integrity
- History of seizures
- Pacemaker
- MMSE < 24
- Impaired communication skills
- Pain in UE limiting function
- History of peripheral neuropathy

Outcome Measures

- ⊙ Light Touch with Monofilaments (Impairment)
 - Involved and uninvolved extremities tested
 - C5-T1
- ⊙ Nottingham Stereognosis (Impairment)
 - 10 specific objects placed in involved extremity
 - Performed with eyes closed
- ⊙ Wolf Motor Function Test (Function)
 - Assessment of 17 items score from 0-5 and time to complete task
 - Gross and fine motor
- ⊙ QuickDASH Outcome Measure (Participation)
 - Subjective quality of life assessment

Tools

NAME OF TEST	RELIABILITY	INTRRATER RELIABILITY	INTERNAL CONSISTENCY	TEST-RETEST RELIABILITY	VALIDITY
WMFT	N/T	.97 and .88	.89 and .92	.90 and .95	N/T
Nottingham Stereognosis	N/T	.67 (more affected side) .85 (less affected side)	N/T	N/T	N/T
QuickDASH	.90	N/T	.88	.95	95%
Light Touch and Sensory Assessment	.83	.72	N/T	.38-.54	3-5 uses

Timeline of Treatment

- Week 1: 2 baseline tests
- Weeks 2-5: 60min/BID at home with no active exercise
 - 2 weekly 60 min sessions at Siskin Hospital
 - Total of 56 treatments
- Week 6: Post-test
- Week 11: Follow up testing

Protocol Parameters

- Symmetrical biphasic waveform
- Frequency of 5 Hz
- 20 µsecond pulse duration
- Sub-motor level
- Continuous cycle
- Portable TENS unit
- Mesh glove with dispersive electrode

Participant Monitoring

- Treatment twice a week at Siskin
- Daily phone call from student researcher
- Daily logs
 - Student researcher
 - Participant

Participant 1

DEMOGRAPHICS

- 02/1997
- Right basal ganglia CVA
- Previous PT

CONFOUNDING ISSUES

- Spasticity >2 on Modified Ashworth Scale
- Receiving Botox injections

POSITIVE NOTE

- Completed 100% of treatments

Participant 2

- Did not qualify for participation in study
- Unable to meet inclusion requirements
 - MMSE score of 20
 - Severe pain in UE at night
- Received \$25 for initial pre-test at Siskin Hospital

Participant 3

DEMOGRAPHICS

- 10/2004
- L MCA embolic CVA
- Previous PT

CONFOUNDING ISSUE

- Compliance
 - Completed 61% of treatments

Participant 4

DEMOGRAPHICS

- 05/2006
- R MCA CVA
- No previous PT

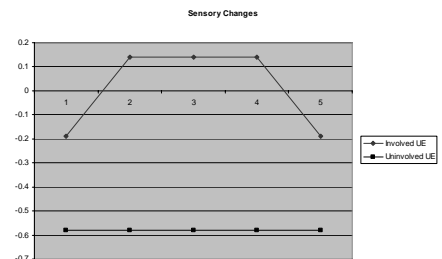
IDEAL PARTICIPANT

- Compliant
 - Completed 100% of treatments
- Spasticity <2 on Modified Ashworth Scale

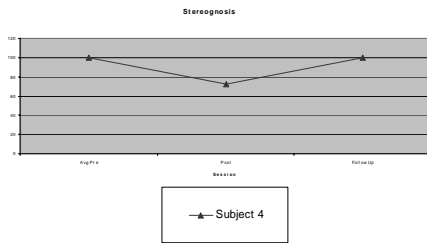
Results

- Participant 1 data excluded due to Botox
 - Improvements in items 1, 11 and 16 on WMFT
 - Negative change on other measures
- Participant 3 data excluded due to compliance
 - Improvements in items 1-5, 10-12, 15 and 17
 - Positive sensory changes on involved UE
- Participant 4 was the IDEAL participant

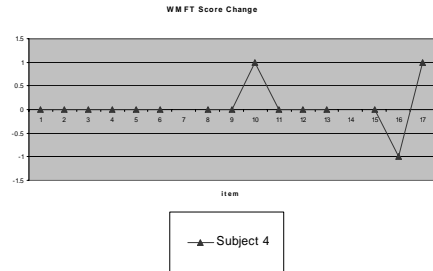
Results



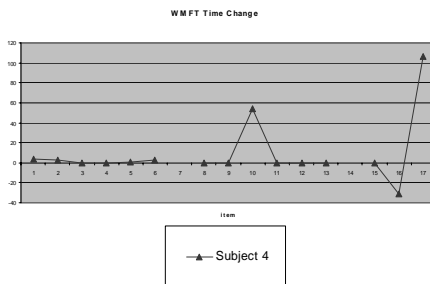
Results



Results



Results



QuickDASH Survey

NEGATIVE CHANGES

- Open a jar
- Do heavy household chores
- Carry a shopping bag/groceries
- Use a knife to cut food

POSITIVE CHANGES

- No interference of L UE with social activities
- No limitations in ADL's as a result of her L UE
- No arm, shoulder or hand pain
- No tingling in arm, shoulder or hand
- No difficulty sleeping due to her L UE

Discussion

- Negative changes in uninvolved UE in sensory
 - Reason unknown
- Variability in stereognosis
 - Changes in researcher at post-test from pre-test and follow-up
- Improvement in WMFT
 - Significant changes with time to perform activity
- Subjective reports of improved function
 - Positive and negative changes noted on QuickDASH
 - Potential misunderstanding of the questionnaire

Similar but Not Quite

PEURALA et al (2002)

- Sub-sensory
- SES glove
- Chronic CVA
- 59 participants
- Placebo and experimental groups
- Functional motor and sensory improvement

OUR RESEARCH

- Sub-motor
- SES glove
- Chronic CVA
- Smaller participant number
- No placebo group
- Functional, gross motor, fine motor and sensory improvements

BOTH WARRANT FURTHER RESEARCH OF SUB-MOTOR e-stim ON UE FUNCTION

Limitations

- Population of convenience
- Small number of participants
- Lack of control group
- Variability in patient population
- Study performed without prior knowledge of PMH
- Inter-rater reliability for stereognosis and sensory < .75
- Inexperience of researchers with tools
- Assessments performed by different researchers

Recommendations

- Modified Ashworth scores added to inclusion/exclusion criteria
- Add medications to inclusion/exclusion criteria
- Explore measurement tools for sensitivity, specificity and clinical usefulness

IRB Modifications

- Patient Demographics
 - Acute CVA
 - Population of convenience
 - No Botox or Baclophen
 - No Modified Ashworth of 2 or greater
- Sensory e-stim in conjunction with standard therapy
 - Total of 2 hours a day
 - 1 hour in conjunction with therapy
 - 1 hour with no active movement
- 40 patients from Siskin Day Hospital
 - 20 with standard care
 - 20 with standard care and sensory treatment
- Intervention and control group
- Same parameters and outcome measurements as this study
- Measurements taken at pre and post study during 4 week study
 - Blinded therapists

References

- Church C, Price C, Pandyan AD, et al. Randomized controlled trial to evaluate the effect of surface neuromuscular electrical stimulation to the shoulder after acute CVA. *CVA*. 2006;57:2995-3001.
- de Kroon JR, Izerman MJ, Chae J, et al. Relation between stimulation characteristics and clinical outcomes in studies using electrical stimulation to improve motor control of the upper extremity in CVA. *J Rehabil Med*. 2005;37:69-74.
- Alon G, Sunnerhagen KS, Geurts AC, Ohry A. A home based self administered stimulation program to improve selected hand functions of chronic CVA. *Neuro Rehabilitation*. 2009;8:219-222.
- Powell J, Pandyan D, Granat M, et al. Electrical Stimulation of wrist extensors in postCVA hemiplegia. *CVA*. 1999;30:1384-1389.
- Yozbatiran N, Dönmez Kayak N, Bozan O. Electrical Stimulation of wrist and fingers for sensory and functional recovery in acute hemiplegia. *Clinical Rehabilitation*. 2006;20:4-11.
- Hummelshiem H, Maier-Loth ML, Eickhof C. The functional value of electrical muscle stimulation for the rehabilitation of the hand in CVA patients. *Scand J Rehab*. 1997;29:3-10.
- Gummesson C, Ward MM, Atroshi I. The shortened disabilities of the arm, shoulder, and hand questionnaire: validity and reliability based on responses within the full-length DASH. *BMC Musculoskeletal Disorders*. 2006;7:1-7.
- Kimberley TJ, et al. Electrical stimulation driving functional improvements and cortical changes in subjects with CVA. *Exp Brain Res*. 2004;154:450-463.
- Yozbatiran N, Bonnez B, Kayak N, Bozan O. Electrical stimulation of wrist and fingers for sensory and functional recovery in acute hemiplegia. *Clinical Rehabilitation*. 2006; 20: 4-11.
- Sullivan JE, Hedman LD. A home program of sensory and neuromuscular electrical stimulation with upper-limb task practice in a patient 5 years after a CVA. *Physical Therapy*. 2004; 84: 1045-1054.
- Peurala SH, Pitkanen S, Sivonius J, Tarkka IM. Cutaneous electrical stimulation may enhance sensorimotor recovery in chronic CVA. *Clinical Rehabilitation*. 2002; 16: 709-716.
- Gaubert CS, Mockett SP. Inter-rater reliability of the Nottingham method of stereognosis assessment. *Clinical Rehabilitation*. 2000; 14: 157-159.
- Morris DM, Uswatte G, Crago JE, Cook III EW, Taub E. The reliability of the wolf motor function test for assessing upper extremity function after CVA. *Arch Phys Med Rehabil*. 2001; 82: 750-755.



Questions??

THANKS!!!

- Chattanooga Group for your monetary support
- Siskin Hospital for allowing us to borrow your therapists and your space
- Dr. Fell, our research advisor
- Our participants for completing the study
- And a shout out to Dr. Ketchum, as of May 2008, for help with our IRB