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TO THE TAILWIND/BILATERAL ARM
TRAINER WITH RHYTHMIC AUDITORY
CUEING (BATRAC)**



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BILATERAL AND UNILATERAL ARM TRAINING IMPROVE MOTOR FUNCTION THROUGH DIFFERING NEUROPLASTIC MECHANISMS: A SINGLE-BLINDED RANDOMIZED CONTROLLED TRIAL. WHITALL, J., MCCOMBE WALLER, S., SORKIN, J., THE BALTIMORE PEPPER TEAM, GOLDBERG, A., (2010) NEUROREHABILITATION AND NEURAL REPAIR, XX(X) 1-12

In this study of 111 adults with chronic UE paresis, participants were randomly assigned BATRAC training or dose matched therapeutic exercises. Both groups improved motor function, but both participant satisfaction AND adaptations in brain activation are greater after BATRAC.

TEMPORAL AND SPATIAL CONTROL FOLLOWING BILATERAL VERSUS UNILATERAL TRAINING. MCCOMBE WALLER, S., LIU, W., AND WHITALL, J., (2008) HUMAN MOVEMENT SCIENCE, 27(5): 749-758

In this small randomized controlled study, improvements in both spatial and temporal control of the arms during bilateral reaching tasks after 6 weeks of BATRAC training compared to 6 weeks of unilateral arm training were demonstrated. This study emphasized the importance of examining bilateral arm motor function after bilateral arm training and the inclusion of measures of temporal and spatial control. Abstract: <http://tinyurl.com/mqy7cn>

BILATERAL ARM TRAINING: WHY AND WHO BENEFITS? MCCOMBE WALLER, S., & WHITALL, J. (2008) NEUROREHABILITATION, 23(1), 29-41.

This paper discusses the benefits and utility of bilateral arm training for stroke patients with paralysis of all severity levels. Abstract: <http://iospress.metapress.com/content/m4174u412t366281/>

MOTOR FUNCTION IMPROVEMENT IS ASSOCIATED WITH BRAIN RE-ORGANIZATION AFTER BILATERAL ARM TRAINING IN CHRONIC STROKE – CASE REPORT. WHITALL, J., MCCOMBE WALLER, S., LUFT, A., HANLEY, D. (2006). PHYSIOSCIENCE, 2, 93-98.

In this case report, one subject with chronic hemiparesis demonstrated motor function gains as well as new contralesional activation after 6 weeks of BATRAC. (English-language version not available online.)

HAND DOMINANCE AND SIDE OF STROKE AFFECT REHABILITATION IN CHRONIC STROKE. MCCOMBE WALLER, S., & WHITALL, J. (2005) CLINICAL REHABILITATION, 19(5), 544-51.

This study compared the effect of 6 weeks basic BATRAC across those whose lesion was in their motor dominant (left) vs. motor non-dominant (right) hemisphere. There were no baseline differences between the groups but a clear training response advantage in those with left hemisphere lesions who responded positively to more outcome measures. Abstract:

<http://cre.sagepub.com/cgi/content/abstract/19/5/544>

FINE MOTOR CONTROL IN ADULTS WITH CHRONIC HEMIPARESIS: BASELINE COMPARISON TO NON-DISABLED ADULTS AND EFFECTS OF BILATERAL ARM TRAINING. MCCOMBE WALLER, S., & WHITALL, J. (2004) ARCHIVES OF REHABILITATION AND PHYSICAL MEDICINE, 85:1076-83.

This study demonstrated that individuals with chronic stroke had disruption of non-paretic finger consistency in bilateral tapping which was improved after 6 weeks of basic BATRAC. Thus despite the apparent lack of training specificity there were some generalizable effects from BATRAC to fine-motor interlimb coordination. In addition for the four subjects who could manage unilateral paretic finger tapping, two improved their unilateral paretic performance post training while 2 had equivocal results.

Abstract: [http://www.archives-pmr.org/article/S0003-9993\(04\)00019-X/abstract](http://www.archives-pmr.org/article/S0003-9993(04)00019-X/abstract)

REPETITIVE BILATERAL ARM TRAINING AND MOTOR CORTEX ACTIVATION IN CHRONIC STROKE. LUFT, A.R., MCCOMBE WALLER, S., WHITALL, J., FORRESTER, L.W., MACKO, R.F., SORKIN, J.D., SCHULZ, M.D., GOLDBERG, A.P., HANLEY D. (2004) JOURNAL OF AMERICAN MEDICAL ASSOCIATION, 292:1853-61.

This study was a small randomized control trial using fMRI to document re-organization in central motor networks. Six of 9 individuals who had BATRAC training demonstrated re-organization in contralesional motor networks. This re-organization was not demonstrated in those who undertook a dose-matched therapeutic exercise (DMTE) control therapy. In addition, when the non-responders after BATRAC were eliminated from analysis, the BATRAC group showed a differential increase in FM scores. Abstract:

<http://jama.ama-assn.org/cgi/content/abstract/292/15/1853>

REPETITIVE BILATERAL ARM TRAINING WITH RHYTHMIC AUDITORY CUEING IMPROVES MOTOR FUNCTION IN CHRONIC HEMIPARETIC STROKE. WHITALL, J., MCCOMBE WALLER, S., SILVER, K.C., & MACKO, R.F. (2000) STROKE: A JOURNAL OF CEREBRAL CIRCULATION, 31:2390-2395.

This study demonstrated the feasibility of BATRAC with a one group design in individuals with chronic stroke. After 18 sessions (about 6-8 weeks) of preferred speed exercise on BATRAC (4 x 5mins) there was a significant increase in the scores of Fugl Meyer (FM), Wolf time and the University of Maryland Arm Questionnaire for Stroke. The increase was maintained after 9 weeks of no exercise. Abstract: <http://stroke.ahajournals.org/cgi/content/abstract/31/10/2390>

Related Articles:

BILATERAL ARM TRAINING WITH RHYTHMIC AUDITORY CUEING IN CHRONIC STROKE: NOT ALWAYS EFFICACIOUS. RICHARDS, L., SENESAC, C., DAVIS, S., WOODBURY, M., NADEAU, S., (2007) NEUROREHABILITATION AND NEURAL REPAIR, 2008: 22; 180.

The authors tested a modified form of BATRAC in a new group of participants with a condensed treatment regime to determine whether they could replicate previously reported results. After 2 weeks of training, 14 subjects did report increased use of their paretic arm, although no significant changes were observed in the Fugl-Meyer or Wolf Motor Function Test scores. The authors conclude that these differences may reflect a more temporally condensed training schedule and less impaired patients. Abstract: <http://nnr.sagepub.com/cgi/rapidpdf/1545968307305355v1.pdf>

CORTICAL REORGANIZATION INDUCED BY TASK-ORIENTED TRAINING IN CHRONIC HEMIPLEGIC STROKE PATIENTS. JANG, S., KIM, Y., CHO, S., LEE, J., PARK, J., & KWON, Y. (2003) NEUROREPORT, 14(1), 137-141.

This study involved task-oriented training and its effect on the cortex of hemiparetic stroke patients. The training occurred 40 minutes a day four days a week for four weeks. Information gathered from the research was assessed by fMRI. Subjects were asked to perform six tasks that affected upper extremity function such as switching two switches, five different color switches, grasping and release, transferring objects from one location to another, and throwing balls. The outcome was visually positive. The fMRI results showed the affected contralateral sensorimotor cortex was newly activated when subject performed hand movements. Overall, an increase in cortical reorganization was evident in affected sensorimotor cortex activity and a decrease of sensorimotor cortex activity was seen in unaffected areas. Abstract: <http://tinyurl.com/n39khj>

FUNCTIONAL NEUROIMAGING STUDIES OF MOTOR RECOVERY AFTER STROKE IN ADULTS: A REVIEW. CALAUTTI, C., & BARON, J. (2003) STROKE; A JOURNAL OF CEREBRAL CIRCULATION, 34(6), 1553-1566.

This study was performed to provide evidence of motor neuron reorganization with functional neuroimaging. The authors were able to accumulate sufficient data that proved reorganization of the motor system from functional MRI (fMRI) or positron emission tomography imaging. Recovering stroke patients participated in the study. The patients were treated with therapies known to elicit changes in motor networks. Results from imaging showed evidence of reorganization of the affected brain. Abstract: <http://stroke.ahajournals.org/cgi/content/abstract/34/6/1553>

CEREBELLAR HEMISPHERIC ACTIVATION IPSILATERAL TO THE PARETIC HAND CORRELATES WITH FUNCTIONAL RECOVERY AFTER STROKE. SMALL, S.L., HLUSTIK, P., NOLL, D.C., GENOVESE, C., & SOLODKIN, A., (2002) BRAIN: A JOURNAL OF NEUROLOGY, 125, 1544-1557.

The authors of this study evaluated twelve patients over the first six months of stroke recovery using fMRI. The stroke caused all patients unilateral arm weakness. The researchers sought to determine where an increase in brain activation occurred during stroke recovery. Areas of concern were the brain's primary motor cortex regions contralateral or ipsilateral to the injury and in cortical regions functionally connected to the impaired primary motor cortex with emphasis on the supplementary motor, lateral premotor cortices, and cerebellum. The patients performed tasks often used in motor recovery studies; repetitive index finger tapping, nine-hole peg test, and hand grip strength activities. Earlier research had shown primary sensory and motor cortex contralateral to movements and cerebellar hemisphere ipsilateral to movements are the most significant regions of activation. Cerebellum contralateral to movements of paretic hand showed short-lived increases in activation during recovery but is not linked to recovery. The authors also found that primary sensory and motor cortex ipsilateral to the paretic hand may not have a role in motor recovery from stroke due to less significant activation. There was no difference in primary sensory and motor cortex activation between better or worse recoverers. This study found that the degree of recovery is significantly associated with cerebellar activation ipsilateral to movements of the affected hand but not the injured primary motor cortex. The authors' findings suggest specific treatments be designed to concentrate on enhancing cerebellar hemispheric function on the same side as the hemiparetic hand. Abstract:

<http://brain.oxfordjournals.org/cgi/content/abstract/125/7/1544>

CORRELATION BETWEEN MOTOR IMPROVEMENTS AND ALTERED FMRI ACTIVITY AFTER REHABILITATIVE THERAPY. JOHANSEN-BERG, H., DAWES, H., GUY, C., SMITH, S., WADE, D., & MATTHEWS, P. (2002) BRAIN: A JOURNAL OF NEUROLOGY, 125(P12), 2731-2742.

The authors investigate the relationship between improvements in motor function and functional magnetic resonance imaging (fMRI). Subjects with mild to moderate hemiparesis performed hand therapy. This therapy showed sensorimotor and therapy-mediated improvements that corresponded with increases in fMRI activity. Abstract:

<http://brain.oxfordjournals.org/cgi/content/abstract/125/12/2731>

THAUT, M., KENYON, G., HURT, C., MCINTOSH, G., & HOEMBERG, V. (2002) KINEMATIC OPTIMIZATION OF SPATIOTEMPORAL PATTERNS IN PARETIC ARM TRAINING WITH STROKE PATIENTS. NEUROPSYCHOLOGIA, 40(7), 1073-1081.

The researchers provide insight into effect of rhythm on paretic arm function. The researchers used an isochronous metronome stimulus to prompt reaching movement. The data was then compared to that of non-prompted repetitive training. Because the arm and hand can learn skills involved “high performance environments” such as sports, the authors believed teaching these extremities to operate via rhythmic cue would effectively rehabilitate a paretic arm. To identify the changes realized from the rhythmic cueing, a mathematical optimization model was applied. Data provided by the authors showed a significant improved in arm kinematics exposed to rhythm. With the results obtained from this study; the authors suggest auditory rhythm attributed to significant kinematic stability to the patient’s paretic arm. Abstract: <http://tinyurl.com/n9nkfy>

CAN SIMULTANEOUS BILATERAL MOVEMENT INVOLVE THE UNDAMAGED HEMISPHERE IN RECONSTRUCTION OF NEURAL NETWORKS DAMAGED BY STROKE. MUDIE, M., & MATYAS, T. (2000) DISABILITY AND REHABILITATION, 22(1-2), 23-37.

The authors tested the hypothesis of whether simultaneous bilateral movements encourage the reconstruction of neural networks that have been damaged by stroke. The authors believe bilateral isokinematic training (BIT) can encourage movement pattern reorganization through mechanisms for the hemiplegic extremities that are not accessible by unilateral training. Twelve patients participated in eight weeks of training utilizing three standardized “reach-to-target” tests. The results of this study showed BIT improved kinematic patterns of unilateral hemiplegic limb performance rapidly in patients. Abstract: <http://www.informaworld.com/smpp/content~db=all~content=a769984879>

A FUNCTIONAL MRI STUDY OF SUBJECTS RECOVERED FROM HEMIPARETIC STROKE. CRAMER, S., NELLES, G., BENSON, R., KAPLAN, J., PARKER, R., KWONG, K., ET AL. (1997) STROKE; A JOURNAL OF CEREBRAL CIRCULATION, 28(12): 2518-2527.

This study attempted to understand recovery mechanisms in recovering stroke patients. In this study, the authors used fMRI as a tool to compare brain activations of a control subject to that of an affected subject. Finger tapping exercises were used to generate brain activation in the recovered hand. Evidence of activation was shown through fMRI activation images. When comparing the results to controls, the authors found that the recovering subjects experienced activation of the same motor regions as the controls. The authors concluded that this study provided enough evidence to prove several processes may be related to restoring neurologic function in individuals who have suffered a cerebrovascular accident. Abstract: <http://stroke.ahajournals.org/cgi/content/abstract/28/12/2518>

REPETITIVE TRAINING OF ISOLATED MOVEMENTS IMPROVES THE OUTCOME OF MOTOR REHABILITATION OF THE CENTRALLY PARETIC HAND. BÜTEFISCH, C., HUMMELSHEIM, H., DENZLER, P., & MAURITZ, K. (1995) JOURNAL OF THE NEUROLOGICAL SCIENCES, 130(1), 59-68.

The authors investigate the effects of repetitive training to rehabilitate a paretic hand. To achieve a baseline, patients received normal treatments utilizing the Bobath concept, a conventional physiotherapeutic method. Using a multiple baseline approach, the authors were able to analyze the effect of specific trainings on three basic motor function of the hand; grip strength, isometric and isotonic hand extension. Twenty-seven hemiparetic individuals were placed into two groups; one receiving enhanced non-specific therapy and another receiving enhanced specific therapy. Group one received specific standardized training using rapid and repetitive movements trained twice a day for 15 minute periods. The second group was exposed to transcutaneous electrical nerve stimulation (TENS) as an enhanced non-specific intervention for the same amount of time as group one following the baseline phase. Group two received the same training as group one after completion of the TENS treatment. As a result, TENS did not achieve a reasonable improvement when compared to the baseline. It was also deduced the standardized motor training was successful in improving specific movement parameters of the hand as well as its functional motor deficit significantly (Bütefisch et al. 1995). The authors consider repetitive training is crucial for the course of motor recovery. Abstract:

<http://www.ncbi.nlm.nih.gov/pubmed/7650532>