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Research Article

Results of a neurocognitive training therapeutic program for memory/neurocognitive deficits in adults with traumatic brain injury over time

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Abstract

Adults diagnosed with a traumatic brain injury (referral by physician or neurologist) using neuropsychological evaluation, participated in a neurocognitive training program typically ranging for six months to one year. Patients are seen twice per week for an hour session. There is an overflow program provided for home. Neurocognitive training is provided by a therapist using over 200 different games and activities as part of an individualized program designed to treat the identified memory and neurocognitive deficits identified by neuropsychological evaluation. Programs are individualized, modified and changed during the course of treatment with the goal of continually challenging the patient. Evaluation was compared for pre and post-testing yielding significant differences in memory function; areas of overall memory, visual, verbal, delayed, working memory, recall, and recognition memory. Positive feedback was reported by the adults who noticed changes in their functioning in their everyday life.

Keywords : Neuropsychological testing; Neurocognitive intervention; Adults and traumatic brain injury

Introduction

The numbers of TBI (traumatic brain injury) are rising, 2.8 million are estimated, most TBI events that occur are labeled mild and post-concussive [1]. There tends to be more documentation of the use of neurocognitive rehabilitation for dementia than TBI (Traumatic Brain Injury). Mobile technology and social support has been investigated to provide cognitive rehabilitation with veterans diagnosed with brain injury. Negative findings were seen for executive dysfunction however there were positive results for emotional dysregulation and reduced trauma symptoms [2]. Cognitive rehabilitation is based upon the principles of brain neuroplasticity and restoration; a review of the literature revealed that cerebral activation may be significantly modified by cognitive rehabilitation regardless of the severity of the injury. A meta-analysis revealed improvement in overall mental function, daily living skills, as well as values, beliefs and spirituality as a result of occupation based cognitive rehabilitation. The role of exercise has been examined and may be a helpful intervention for cognitive recovery from TBI. A literature review of studies examining computer-based interventions reported methodological issues; pre-injury co-morbidities that could impact cognitive performance which were not assessed, lack of a standard method for assessing the severity of the brain injury, the inclusion of a wide variety of etiologies for acquired brain injury and overall weak evidence of the improvement of cognitive function [3-6].

In a clinic setting we have been providing treatment for traumatic brain injury for 15 years (2003). Treatment at this facility in the form of cognitive rehabilitation has been successful in producing positive changes for brain injured patients seen on pre-and post-testing comparisons [7-11]. The current study is an analysis of the ongoing sample of patients to assess the effectiveness of this therapeutic program utilized in an outpatient treatment setting to address memory and neurocognitive deficits determined through neuropsychological testing conducted prior to and following therapeutic intervention in an adult clinic population.

Methods

Adults are referred for assessment of memory and neurocognitive deficits following a documented traumatic brain injury (age 19 to 78 years, n=63) by their treating physician and/or neurologist. Educational level ranged from high school to graduate degrees. Neuropsychological assessment was completed ruling in a traumatic brain injury and/or post-concussion effects. Malingering is addressed with specific measures and ruled out using the TOMM and Hiscock Abbreviated Memory Test [12-13]. An abbreviated intellectual assessment was administered using the Wechsler Abbreviated Scale of Intelligence-Second Edition (WASI-II) [14].

A baseline was established assessing memory and executive function. The Doors and People Test, Brief Visuospatial Memory Test-Revised (BVMT-R), and Repeatable Battery for the Assessment of Neuropsychological Status (RBANS) were common neuropsychological test measures utilized to assess areas of functioning prior to and following participation in

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a therapeutic treatment program. Comparison of initial and repeated evaluation over time intervals was assessed. Six months was the average for the time between pre and post testing.

The RBANS has been used extensively for critical care and in research with patients diagnosed with cognitive deficits or dementia. The Doors and People is an accepted memory test for visual and verbal retrieval and recognition. The BVMT-R has been used in the aged population as a measure of visual memory [15-20].

The neurocognitive training occurs generally twice per week and a carry-over program is provided for patients to work on their treatment program in the home setting. Each treatment program is different and dependent upon the results of the neuropsychological evaluation. Deficits such as word retrieval, different facets of memory (working memory, verbal and visual memory, retrieval and recognition, short term recall) as well as executive deficits impacting memory function (selective attention, integration, perseveration, sequential processing) are examples of what might be addressed in the individualized treatment protocol.

There are over 200 games and activities to choose from, some have been created based upon theoretical concepts while others modify available published games based upon individual needs and the individualized treatment regimen. During the course of therapy, the activity or use of the game is altered; speed may be an additional variable, increased task difficulty may be accomplished by altering instructions. As improvement and ease of completion is noted by the therapist the task is intensified or another, more difficult task is chosen.

An individualized specific plan is followed by the therapist for each patient. One example is the use of a Geoboard that involves the copying and/or memory of patterns created with different colored rubber bands, inherent in the task is increasing complexity. The task involves the use of planning, memory processes, integration, selective attention and visual perceptual analysis.

Results

Findings revealed statistically significant differences in scores for initial and re-evaluation testing following treatment. Paired samples t-tests revealed significant differences between initial and re-evaluation scores for the attention functioning on the RBANS (p= 0.002), overall memory (p= 0.004), delayed memory (p= 0.025) and visual memory (p= 0.007). Significant findings also occurred on the Doors and People Test for the people test, involving verbal memory (p= 0.003), as well as overall verbal memory (p= 0.034).

Significant findings were also present on the BVMT-R for the initial learning trial (p= 0.002), the second learning trial (p= 0.007), the third learning trial (p= 0.011), overall recall (p= 0.036) and delayed memory (p= 0.011). There were significant pre and post evaluation differences for the WRAML-2 verbal memory (p= 0.032), visual memory (p= 0.001), general memory (p= 0.000), working memory (p= 0.029), visual recognition (p= 0.033) and general recognition (p= 0.049). On the MAS there was a significant difference for visual memory (p= 0.007) (Tables 1-17).

Table 1. Effect of cognitive training on attention functioning.

		Pre-Testing	Post-Testing
RBANS Attention	Mean ± SD	81.03 25.30	90.17 25.79

Table 2. Effect of cognitive training on delayed memory performance.

		Pre-Testing	Post-Testing
RBANS Delayed Memory	Mean ± SD	83.13 20.55	91.65 22.87

Table 3. Effect of cognitive training on total memory performance.

		Pre-Testing	Post-Testing
RBANS Total Memory	Mean ± SD	82.31 21.69	90.89 24.41

Table 4. Effect of cognitive training on overall verbal memory performance.

		Pre-Testing	Post-Testing
Doors and People Recall of Names	Mean ± SD	6.19 3.08	7.54 3.86

Table 5. Effect of cognitive training on overall verbal memory performance.

		Pre-Testing	Post-Testing
Doors and People Verbal Memory	Mean ± SD	6.94 3.65	8.15 3.65

Table 6. Effect of cognitive training on visual memory performance.

		Pre-Testing	Post-Testing
MAS Visual Memory	Mean ± SD	89.89 17.31	96.5 16.61

Table 7. Effect of cognitive training on verbal memory performance**.**

		Pre-Testing	Post-Testing
WRAML Verbal Memory	Mean ± SD	87.43 14.53	92.28 17.33

Table 8. Effect of cognitive training on visual memory performance.

		Pre-Testing	Post-Testing
WRAML Visual Memory	Mean ± SD	94.93 19.88	104.87 20.16

Table 9. Effect of cognitive training on general memory performance.

		Pre-Testing	Post-Testing
WRAML General Memory	Mean ± SD	87.89 18.94	98.78 23.64

Table 10. Effect of cognitive training on working memory performance.

		Pre-Testing	Post-Testing
WRAML Working Memory	Mean ± SD	90.69 13.37	95.43 16.89

Table 11. Effect of cognitive training on visual recognition performance.

		Pre-Testing	Post-Testing
WRAML Visual Recognition	Mean ± SD	101.90 20.79	108.90 19.14

Table 12. Effect of cognitive training on general recognition performance.

		Pre-Testing	Post-Testing
WRAML General Recognition	Mean ± SD	106.0 10.44	108.90 19.14

Table 13. Effect of cognitive training on visual memory performance.

		Pre-Testing	Post-Testing
BVMT-R Trial One	Mean ± SD	40.93 15.06	48.50 14.20

Table 14. Effect of cognitive training on visual memory performance.

		Pre-Testing	Post-Testing
BVMT-R Trial Two	Mean ± SD	43.06 14.50	49.06 13.09

Table 15. Effect of cognitive training on visual memory performance.

		Pre-Testing	Post-Testing
BVMT-R Trial Three	Mean ± SD	44.13 15.41	49.58 11.38

Table 16. Effect of cognitive training on overall memory performance.

		Pre-Testing	Post-Testing
BVMT-R Overall Memory	Mean ± SD	39.75 14.10	45.21 14.61

Table 17. Effect of cognitive training on delayed memory performance.

		Pre-Testing	Post-Testing
BVMT-R Delayed Memory	Mean ± SD	44.50 15.81	50.59 11.41

Conclusions

Findings suggest the benefit of neurocognitive rehabilitation using a variety of games and activities administered as an individualized program in a therapeutic setting to improve memory functioning in a clinic population of adults diagnosed with traumatic brain injury. Improvements in the areas of overall memory, visual, verbal, delayed, working memory, recall, and recognition memory were accomplished in typically 6 months to one year of treatment and results indicate that memory gains extended to a longer duration of time (6 months to over one year) of treatment. This is significant considering the variable nature of traumatic brain injury that a lasting and consistent difference remained in critical areas of functioning.

Limitations of the Study

This study lacks experimental design and a matched patient control group. This is a clinical study completed in an outpatient setting lacking the wherewithal to incorporate an experimental design. Patients become their own control which addresses the medication issue, typically there were a number of medications to address pain and sleep. Sleep is another variable that would be patient specific as well.

There is always the risk of a practice effect given the familiarity with the measure however in testing individuals with memory difficulties this becomes less of an issue. Six months has been the general known rule for practice effects no longer being considered as a variable which is specifically noted in various test manuals. On the RBANS there was a largely absent practice effect after one year, mean re-test scores increased by 5 points for the index scores excluding language which was 2 points after 39 weeks. Depending upon the form, there was a gain of 2 to 4 raw score points for the BVMT-R after 56 days in healthy participants. On the Doors and People Test there was no change in the brain injured group over time. Testing typically was six months or greater [15-20].

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