A Multi-Disciplinary Treatment Program for Patients With Post-Concussive Syndrome

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Medical Director: NeuroGrow Brain Fitness Center

Affiliate Staff: Johns Hopkins Medicine
Neuroplasticity in the Human Brain:

My Research & Publications
Objectives

➢ The story of a teenager with post-concussive syndrome

➢ Five reasons some patients have persistent post-concussive symptoms for months to years

➢ Five key components of a multi-disciplinary “concussion recovery program”
Michelle’s Story

- Sensitive to sounds, lights, and people
- Constant headaches, almost daily
- Felt dizzy and was sensitive to moving her head
- Difficulty performing simple tasks, even crossing the street
- Unable to go to school
- Stopped many of her extra-curricular activities such as music
- Depressed, hopeless
- For one year, had seen dozens of specialists and received frequent tests, eye movement therapy, massage, acupuncture, and tried different medication
- Nothing had worked; she and her family were frustrated
  - WHAT HAPPENED TO HER BRAIN?
  - WHY WAS SHE NOT GETTING BETTER ONE YEAR LATER?
TBI Causes Micro-tears in Axons
Torn Neuronal Connections: Diffuse Axonal Injury
Trauma to Brain, Inner Ear. and Spinal Cord
Common Causes of Post-Concussive Dizziness

- Labyrinthine & VN injury
- Vestibular Migraine
- Meniere’s Disease
- BPPV
- Medication side-effects
Symptoms Depend on Location and Angle of Trauma
Objectives

➢ The story of a teenager with post-concussive syndrome

➢ Five reasons some patients have persistent post-concussive symptoms for months to years

➢ Five key components of an effective “concussion recovery program”
1. Multiple expert opinions, multiple therapies
2. Many Symptoms, Each Worsening Other

- Headache, Dizziness, and Hyper-sensitivity
- Mood, Irritability, And Sleep Problems
- Memory & Attention Deficits
3. Fragmented Care, in Different Facilities
4. No universally accepted outcome measure for monitoring patients
5. False Recovery, Return to Study or Work Too Soon

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Key Components of NeuroGrow Concussion Recovery Program

1) Making an accurate diagnosis, with emphasis on understanding patient’s pre-existing conditions

2) One person in charge of all of patient’s symptoms

3) Becoming patient’s advocate (addressing and obtaining support from family, school, and employer)

4) Multi-disciplinary approach (e.g. vestibular exercises, stress reduction, exercise, meditation, and brain training)

5) Objective measurements for monitoring progress, until full recovery is achieved
Concussion Recovery Program: Overview

- Initial appointment with neurologist
- Diagnostics
- Concussion Recovery Program
- Follow-Up
Concussion Recovery Program: Initial Comprehensive Assessment

- Depression, Anxiety, ADHD
- Smoking
- Gum disease
- Thyroid problems
- Lung disease
- Liver damage
- Back pain
- Sexual dysfunction and menopause

- Insomnia
- Vision problems
- Snoring
- Hearing loss
- Allergies
- Medications
- Heart disease
- Vitamin D deficiency
- Urinary frequency
- Edema
- Numbness

Conditions that impact brain function
Concussion Recovery Program: Comprehensive Diagnostic Tests

- Neuro-cognitive Evaluation
- Brain MRI
- Cardiopulmonary Testing
- Blood Test
- Sleep Assessment
- Brain Mapping qEEG
Concussion Recovery Program: Complete Cognitive Evaluation

Results Summary

- MoCA: 93
- Composite/Working Memory: 19
- Verbal Immediate and delayed Memory: 32
- Visual Immediate and Delayed Memory: 18
- Attention: 27
- Processing Speed: 75
- Executive Functioning: 8
Concussion Recovery Program: Cognitive Symptoms

Neuro-Cognitive Symptoms

- Difficulty Paying attention
- Difficulty with organization
- Difficulty with calculating
- Difficulty with planning ahead
- Difficulty with concentrating
- Difficulty with making decisions
- Difficulty with multitasking
- Difficulty with navigation
- Difficulty with processing information quickly
- Difficulty with understanding instructions
- Difficulty with remembering names
- Difficulty with short-term memory
- Difficulty with expressing yourself
- Difficulty with finding words during conversations
Concussion Recovery Program: Behavioral Symptoms

Neuro-Behavioral Symptoms

- Fatigue issues
- Irritability issues
- Anger issues
- Difficulty falling asleep
- Difficulty staying asleep through the night
- Pain issues
- Hypersensitivity (light/sound)
- Headaches
- Tremors
- Mood swings
- Obsessive thoughts
- Compulsive behavior and/or thoughts
- Depressed (feeling sad)
- Difficulty with socializing
- General anxiety
- Hyperactivity
- Agitation symptoms
- Impulsive behavior
- Low motivation and apathy issues
- Frustration issues
Brain Waves: Too Slow vs Too Fast

- Depression
- Low Motivation
- Fatigue
- Poor attention
- Memory loss

- Calm
- Focus
- Optimal sleep

- Insomnia
- Anxiety
- Stress
- Obsessive Thoughts
- Distractibility
Abnormal vs. Normal Brainwave Activity

Abnormal Electrical Activity
Red = Excessive, Blue = Diminished

Green = Normal Electrical Activity
Normal Brain Map
Brain Map #1: Mainly sleep and anxiety issues
Brain Map #2: Mainly memory and attention issues
Brain Map #3: Mainly irritability, and depression issues
Concussion Recovery Program: Overview

- Initial appointment with neurologist
- Diagnostics
- 12 weeks Neurofeedback and Brain Training Twice a week
- Follow-Up
Concussion Recovery Program: Twice Weekly Treatments, 12 Weeks

- Neurofeedback
- Cognitive Skills Training
- Brain Coaching & Meditation
- Nutrition Counseling
- Exercise Training
- Weekly Monitoring
Neurofeedback: Based on Operant Conditioning Learning
Rewarding the Brain When It Improves
Combined Neurofeedback and Heart Rate Variability Training for Individuals with Symptoms of Anxiety and Depression: A Retrospective Study

Elyse K. White¹, Kayleah M. Groeneveld¹, Rachel K. Tittle¹, Nicholas A. Bolhuis¹, Rachel E. Martin¹, Timothy G. Royer², and Majid Fotuhi¹,³
Neurofeedback Improves Cognitive Function and Increases Volume of Cortex

Ghaziri et al. Clin EEG Neurosci 2013; 44 (4) 265-72
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  ➢ Michelle’s story
Michelle’s Cognitive Improvements:
Mid-program results (6 weeks)

Comaprative Results Summary

<table>
<thead>
<tr>
<th></th>
<th>Dec-16</th>
<th>Feb-17</th>
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<tbody>
<tr>
<td>Global Functioning</td>
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<td>30</td>
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<tr>
<td>Neurocognition Index</td>
<td>19</td>
<td>70</td>
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<tr>
<td>Attention</td>
<td>47.5</td>
<td>50.3</td>
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<tr>
<td>Processing Speed</td>
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<td>77</td>
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<tr>
<td>Working Memory</td>
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<td>Verbal Immediate and delayed Memory</td>
<td>32</td>
<td>66</td>
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<tr>
<td>Visual Immediate and delayed Memory</td>
<td>18</td>
<td>94</td>
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<tr>
<td>Executive Functioning</td>
<td>8</td>
<td>77</td>
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Michelle’s Cognitive Improvements: Final results (12 weeks)

<table>
<thead>
<tr>
<th>Measuring Category</th>
<th>Dec-16</th>
<th>Feb-17</th>
<th>Apr-17</th>
<th>Comparison</th>
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<tbody>
<tr>
<td>Neurocognition Index</td>
<td>19</td>
<td>70</td>
<td>79</td>
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<tr>
<td>Visual Spatial</td>
<td>47.5</td>
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<td>92</td>
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<tr>
<td>Attention</td>
<td>75</td>
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<td>19</td>
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<td>97</td>
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<td>Working Memory</td>
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<td>Visual Immediate and delayed Memory</td>
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<td>Executive Functioning</td>
<td>8</td>
<td>77</td>
<td>58</td>
<td>8</td>
</tr>
</tbody>
</table>

The orange bars represent December 2016 results, the blue bars represent February 2017 results, and the green bars represent April 2017 results.
Improvement in Brain Maps
Improvement in Cognitive and Behavioral Symptoms
Michelle’s Cognitive Improvements:  
Six Months After Finishing our Program
Michelle’s Improvements in Lifestyle Choices
Better Diet, Exercise, and Attitude
<table>
<thead>
<tr>
<th>Total Patients</th>
<th>46</th>
<th>Average # of Sessions</th>
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<tbody>
<tr>
<td>Males</td>
<td>35%</td>
<td>Brain Coaching 20</td>
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<tr>
<td>Females</td>
<td>65%</td>
<td>Neurofeedback 23</td>
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<table>
<thead>
<tr>
<th>Average Age</th>
<th>32 years</th>
<th>28%</th>
<th>37%</th>
<th>28%</th>
<th>7%</th>
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<tbody>
<tr>
<td>Age 8-20</td>
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<tr>
<td>Age 20-40</td>
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<td>Age 40-60</td>
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<tr>
<td>60 or older</td>
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<table>
<thead>
<tr>
<th>Average Time Since Concussion</th>
<th>22 months</th>
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<tbody>
<tr>
<td>3-6 months</td>
<td>28%</td>
</tr>
<tr>
<td>6-12 months</td>
<td>20%</td>
</tr>
<tr>
<td>12-36 months</td>
<td>39%</td>
</tr>
<tr>
<td>36 months or more</td>
<td>13%</td>
</tr>
</tbody>
</table>
89% of Patients Had Statistically Significant Improvements in Their Neurocognition Index
Significant Improvement in Common TBI-Related Cognitive Domains

All before-to-after mean of differences changes are significant. Error bars represent SEM.
Pre-Post Change Effect Sizes

Effect Size of Paired Differences (Cohen's $d_z$)

- Complex Attention
- Cognitive Flexibility
- Executive Functioning

Effect Sizes:
- Small
- Medium
- Large

Bar chart showing the effect sizes for pre-post changes in cognitive domains.
Significant Reduction in Sleep, Cognitive, and Behavioral Symptoms

Epworth Sleepiness Scale

Pittsburgh Insomnia

Neurocognitive Symptoms

Neurobehavioral Symptoms
Summary

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➢ Five key components of a multi-disciplinary “concussion recovery program”
Thank You

NeuroGrow Brain Fitness Center
McLean - Tysons Corner

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