Treatment & Research Summary



Cognitive*fx*

The Premier Center for Concussion Treatment



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Table of Contents

1. Introduction

1. The Science Behind Cognitive FX

2. Basic Demographics

3. Explanation of Measurements (SIS, PCSS, & Biomarkers)

4. Symptoms

5. EPIC Treatment

6. Results & FAQs

6. What Is the Average Improvement After EPIC Treatment?

8. Is Improvement Long-Lasting?

8. Does the Brain Heal Itself Without Treatment?

9. Do Symptoms Really Improve in One Week?

11. How Does Age Affect Recovery?

11. Do People Still Improve if They Have Had Multiple Concussions?

12. Do People Still Improve Even if Their Concussion or Brain Injury Was a Long Time Ago?

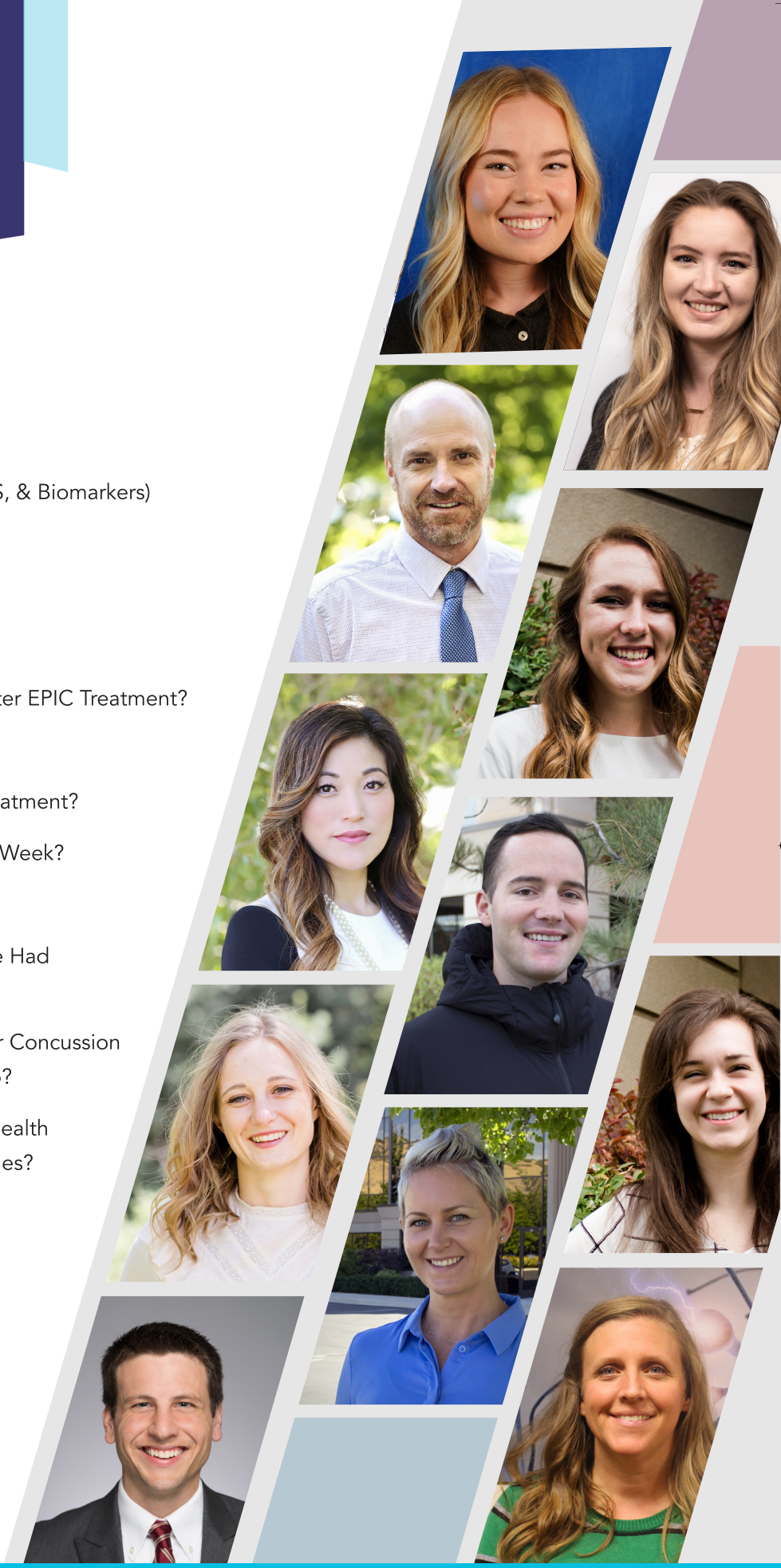
12. Do Depression, Anxiety, or Mental Health Symptoms Affect Treatment Outcomes?

13. Does the Mode of Injury Affect Treatment Outcomes?

13. Does Gender Affect Improvement?

14. Conclusion

15. Research Summaries



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Introduction

Cognitive FX (CFX) is a neurorehabilitation clinic in Provo, Utah, that treats individuals who suffer from concussion and other brain injuries. Using a multidisciplinary team approach, we offer active rehabilitation allowing those who have been injured to sustain a higher quality of life. Cognitive FX began with research in neuroscience imaging and expanded to use that research to guide treatment. We collaborate with scientists at top academic medical institutions as we continue to publish our research in peer-reviewed journals. This research improves our treatment and the standard of care for brain-injury patients world-wide as we contribute to the field of neuroscience and its clinical applications.

Since 2014, CFX has treated almost 1000 concussion and other brain injury patients. This Treatment Summary Report reviews 600 patients treated from August 2014-March 2018 explaining the science, the treatment, and their success. We continue to treat patients every day from around the world.

The Science Behind Cognitive FX

Cognitive FX uses functional NeuroCognitive Imaging (fNCI)—a brain scan similar to functional magnetic resonance imaging (fMRI)—to diagnose and treat concussion. Using fNCI, our doctors create a week-long, multi-faceted treatment targeted to address the specific brain regions affected by each patient's injury. This is called Enhanced Performance in Cognition (EPIC) Treatment.

To understand why we use fNCI at Cognitive FX, you must first understand neurovascular coupling (NVC) and its relation to concussion.

NVC is the connection between neurons (brain cells) and blood vessels. Neurons need a lot of energy to do their job. The blood vessels bring that energy to the neuron. When an injury or neurological disorder occurs, the connection between blood vessels and neurons is strained. Therefore, the brain does not receive the correct amount of energy to work as it needs. This results in symptoms that include, but are not limited to, fatigue, headaches, attention difficulties, memory issues, sleep problems, and emotional distress. If symptoms persist for longer than six weeks, the patient is considered to have post-concussion symptoms (PCS).

It does not work to simply treat PCS by treating symptoms alone. To effectively treat PCS you must treat NVC. This is where fNCI is such a powerful tool. fNCI scans look at how blood flows throughout the brain while the brain is at work. fNCI detects problems with NVC by determining where there is too little or too much activity in key regions of the brain.

At Cognitive FX, we detect existing problems with NVC in the brain using fNCI. The results enable our team to tailor a week of EPIC Treatment for each patient. Treatment addresses the results from the scan and also focuses on reducing individual symptoms. (See Page 16 for research on NVC.)

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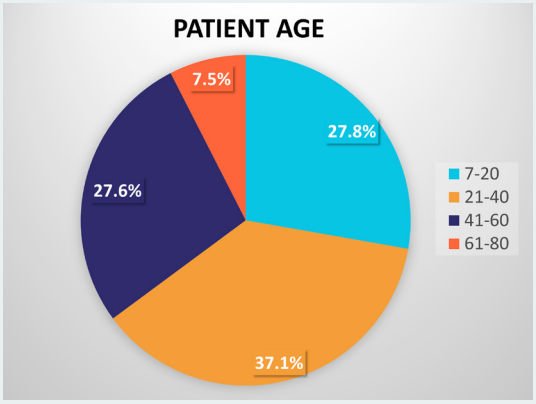
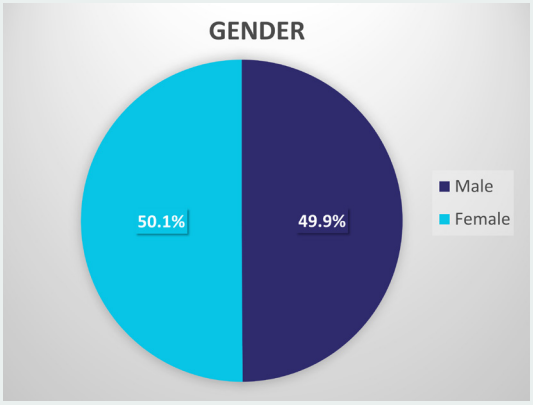
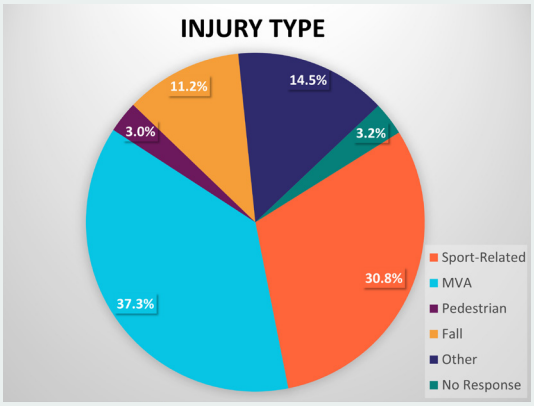
Basic Demographics

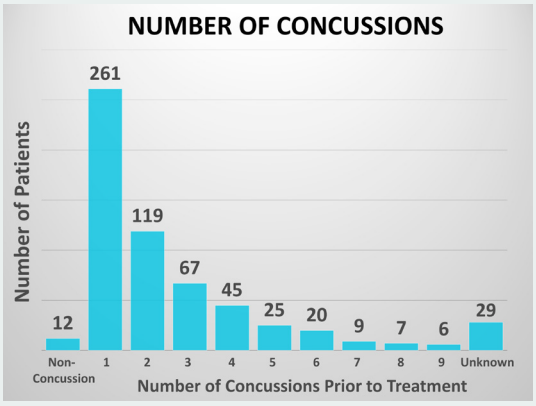
Cognitive FX provides testing and treatment to anyone who qualifies over the age of eight. We treat patients regardless of gender, ethnicity, language, religion, sexual orientation, educational background, or disability. To qualify, we review each potential patient's medical history and injury details to determine if the treatment at Cognitive FX will be beneficial to that specific individual.

The graphs below show the basic demographics of over 600 patients that were treated at Cognitive FX up to March of 2018.



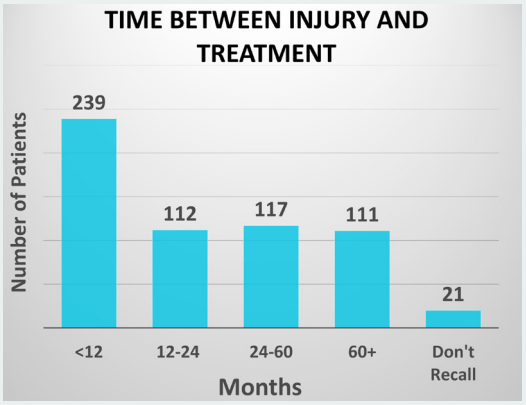






We've treated patients from over 20 countries around the world!





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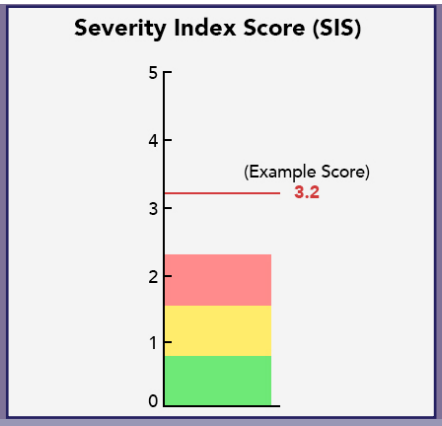
Explanation of Measurements

We have two primary methods of measuring improvement during a patient's week of treatment: Severity Index Score (SIS) which is an objective brain fMRI and Post-Concussion Symptom Scale (PCSS) which is a subjective measure of patients' symptoms. Biomarkers clearly indicate if these symptoms are from a concussion or brain injury.

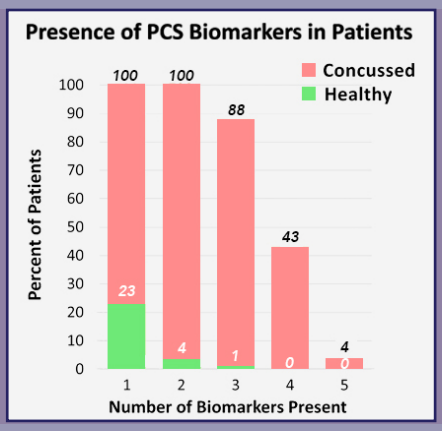
SIS: MEASURING BRAIN ACTIVITY

At the beginning of the week, patients do an fNCI scan to determine which parts of the brain are not working correctly. We compare their scan to a control group of healthy individuals who have never been injured. From that comparison, we calculate a Severity Index Score (SIS). The 0 marks the average for a person with no brain injury. The further away the score is from 0, the more severe the NVC of the concussion or brain injury.



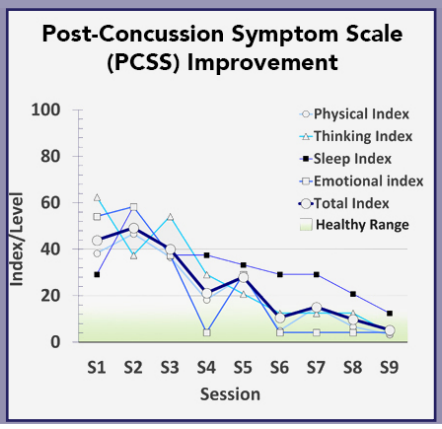
BIOMARKERS

Using the fNCI, we have identified five biomarkers, or patterns of abnormal NVC, that are consistently irregular in concussion patients. These biomarkers can be used to reliably diagnose concussion and other brain injuries. Most concussed brains will meet at least 3/5 biomarkers, while only 1% of healthy brains meet 3/5 biomarkers.



PCSS: MEASURING SYMPTOMS

Each day, patients report their symptoms using the Post-Concussion Symptom Scale (PCSS). PCSS measures four categories: physical, thinking, sleep, and emotional. At the end of the week, patients receive a graph, like the one to the right, that depicts their symptom improvements.



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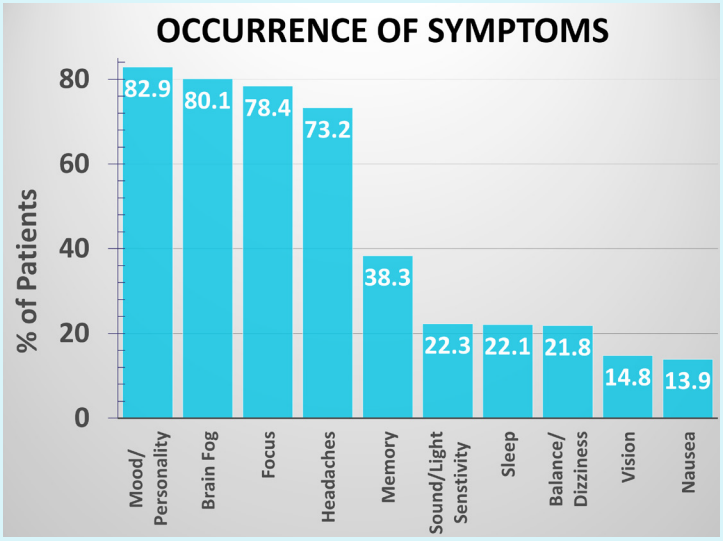
Symptoms

The Top 10 Symptoms of Cognitive FX Patients Before They Come in for EPIC Treatment

- Brain fog
- Lack of focus
- Headache
- Memory difficulties
- Fatigue
- Irritability or nervousness
- Mood disruption
- Sound & light sensitivity
- Sleep problems
- Change in quality of life

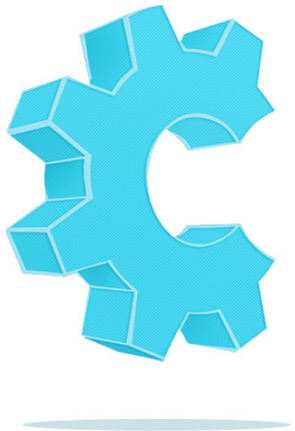
Concussion and other brain injuries can be debilitating. Many experience severe symptoms that interfere with their day-to-day lives, causing problems at work and in personal relationships.

Cognitive FX recognizes that these symptoms are caused by concussion or brain injury.



Summary

When grouped into categories, 82.9% of patients experience mood changes, 78.4% experience loss of focus, and 73.2% experience headaches before they start treatment.



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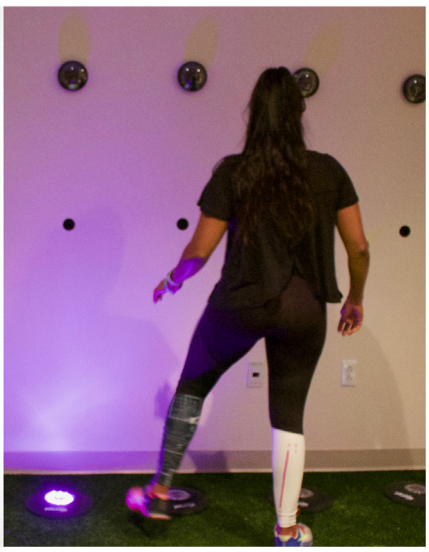
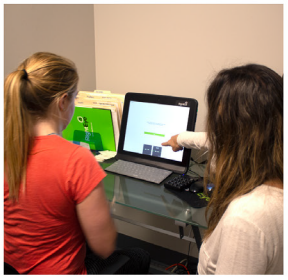
EPIC Treatment






Enhanced Performance In Cognition

EPIC Treatment includes two fNCI scans, a neck and brain MRI, and a week of intensive therapy specific to each patient's brain injury and symptoms. Typically, each patient has a scheduled daily routine from 9 am to 5 pm, including a lunch break. Patients meet with a multidisciplinary team of therapists and trainers each day.

The experience at Cognitive FX is unique because each therapist and trainer is a distinguished professional in their individual field. Our team consists of occupational therapists, neuromuscular therapists, speech and cognition therapists, psychologists, neuroscientists, and neuropsychologists, all of which are under one roof during EPIC Treatment. This makes our clinical approach effective and unique.

Prior to EPIC Treatment many patients have been taught to adjust their life to compensate for their brain injury and their symptoms, leaving many patients with a lower quality of life after an injury. Our focus is not to teach patients how to compensate, but to actively rehabilitate the parts of the brain that have been damaged. With the fNCI, our therapists know exactly what exercises they need to give patients to activate damaged brain regions. Every patient receives tailored treatment unique to their injury and symptoms, enabling them to truly improve and to restore their quality of life over time.

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EPIC Treatment Activities

- Exercises to address cognitive issues, such as processing speed, attention difficulties, sensitivity to noise, and more
- Exercises to address visual problems, including sensitivity to light, vertigo resulting from eye movement or fatigue, balance challenges, and more
- Physical exercises to regulate heart rate and to retrain the body to work better with the brain.
- Guidance to understand how nutrition, hydration, and sleep play a role in brain health during treatment, recovery, and for life
- Neuromuscular therapy to address the most common physical symptoms of concussion, including headaches, dizziness, and nausea
- Brain de-stimulation activities to promote relaxation and encourage the brain to stay in its optimal state of function
- Psychotherapy coupled with mindfulness training, to address the emotional difficulties that come with brain injury
- Training to understand how to continue treatment in everyday life

EPIC Treatment takes the whole team to bring results—including you! Treatment can be challenging, but as our patients, therapists, and trainers work together with a positive attitude, we see extraordinary results.

Results & FAQs

Severity Index Score (SIS)
measures NeuroVascular Coupling (NVC) dysfunction

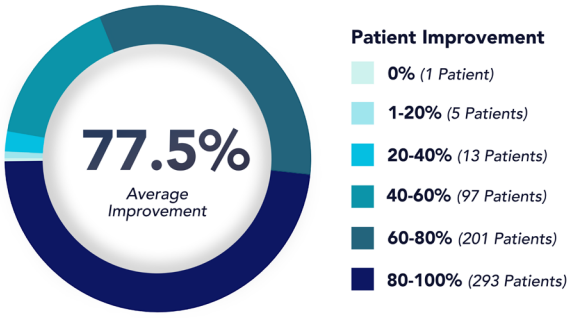
Post Concussion Symptom Scale (PCSS)
measures symptom improvement

What Is the Average Improvement After EPIC Treatment?

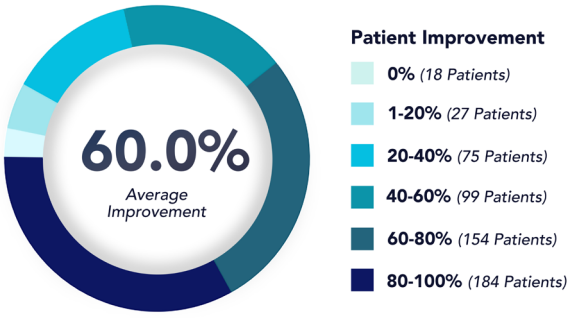
The average SIS improvement after one week of treatment is 77.5%, and most patients improve 60% or more.

The average PCSS improvement after one week of treatment is 60%, and most patients improve 40% or more.

Severity Index Score (SIS)



Post-Concussion Symptom Scale (PCSS)



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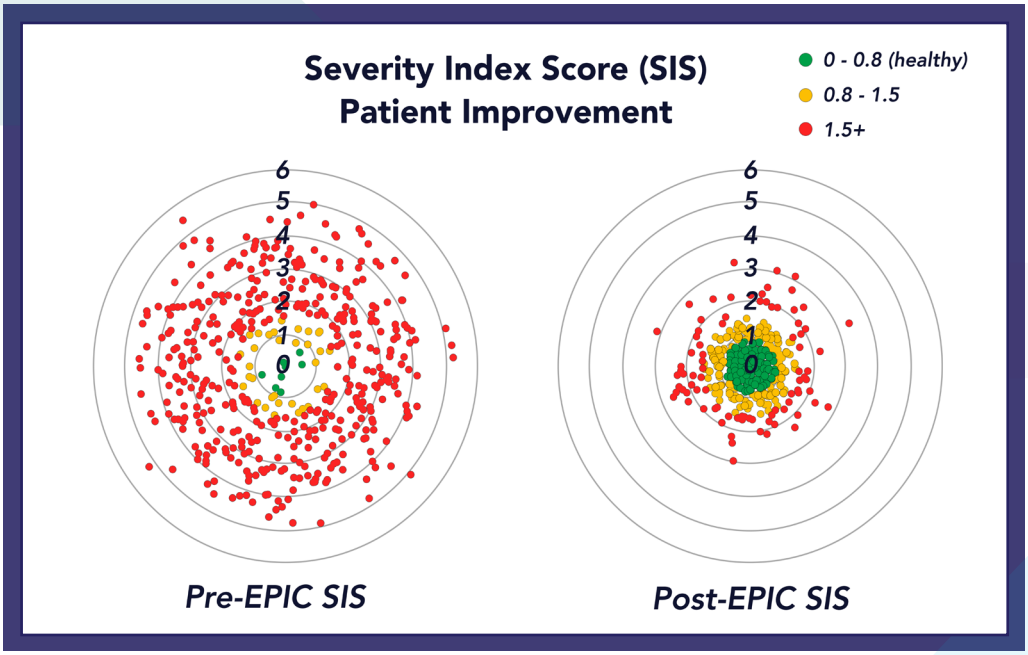
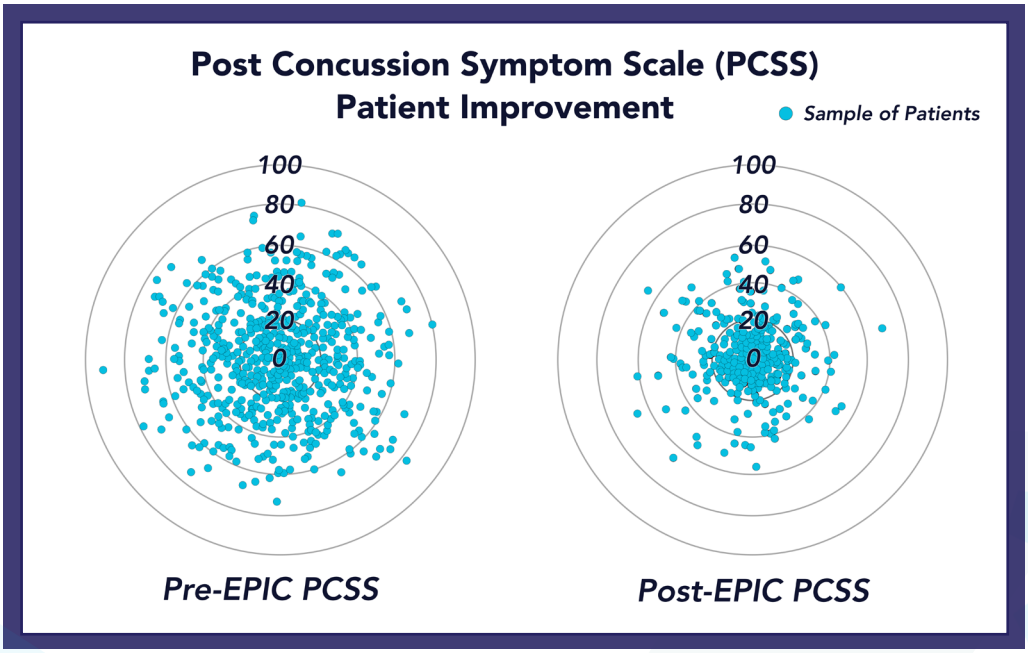


The SIS radar graph shows the Severity Index Score (SIS) of 600 patients. The scale goes from 0-6, with a higher number meaning a more severe injury. Green is considered healthy (0.0-0.8 range). Yellow is considered borderline impairment (0.8-1.5 range). Red is considered mild to moderate impairment (1.5-6.0 range). Most patients have SIS scores in the yellow or red before they begin treatment. After EPIC Treatment, the majority improve significantly, and most patients are within normal limits.



The PCSS radar graph shows the overall severity of symptoms for every patient we have treated and their improvement after one week. The overall score is on a scale from 0-100, with a higher score meaning more symptoms. Before Treatment the average score is 33.6, with an average improvement of 60% in one week.

After one week of treatment, patients experience dramatic improvement in the symptoms they are experiencing.

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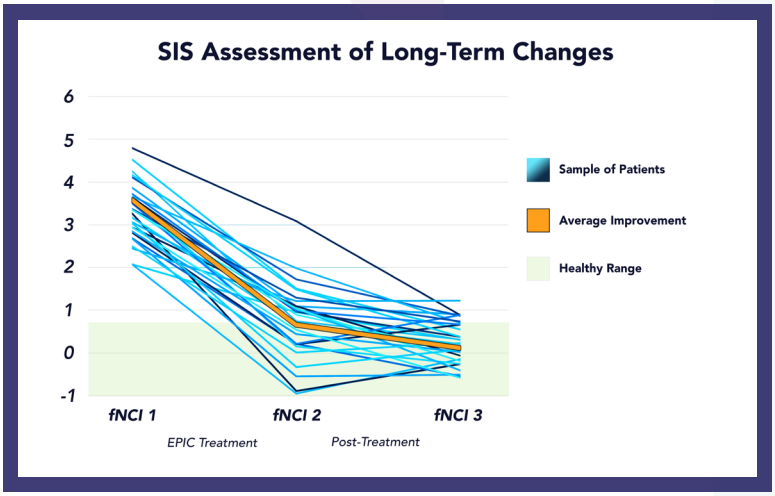
More Results & FAQs

Is Improvement Long-Lasting?

This graph shows 28 patients that have participated in an additional fNCI scan approximately a year following treatment.

We found that patient's scores, on average, continue to improve. This indicates that EPIC Treatment makes permanent changes in the brain to reregulate neurovascular coupling and restore healthy brain function.

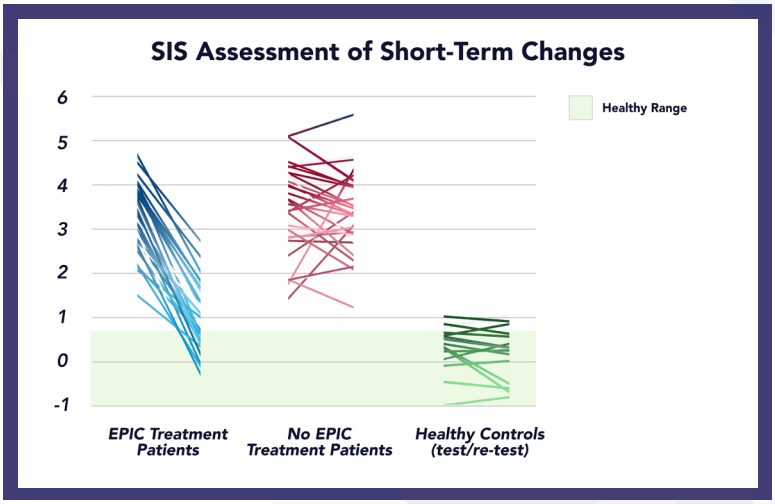


Does the Brain Heal Itself Without Treatment?

This graph shows the difference in SIS scores for those who were injured and participated in EPIC Treatment, those who chose not to participate in EPIC Treatment, and a healthy control group.

After one week of EPIC Treatment, concussed patients showed drastic improvements in brain function. Those who did not participate in EPIC Treatment saw little to no improvements in brain function, and some patients even got worse after an extended period of time.

The healthy control group shows that, on average, a patient's brain maintains the same levels of brain function from scan to scan.





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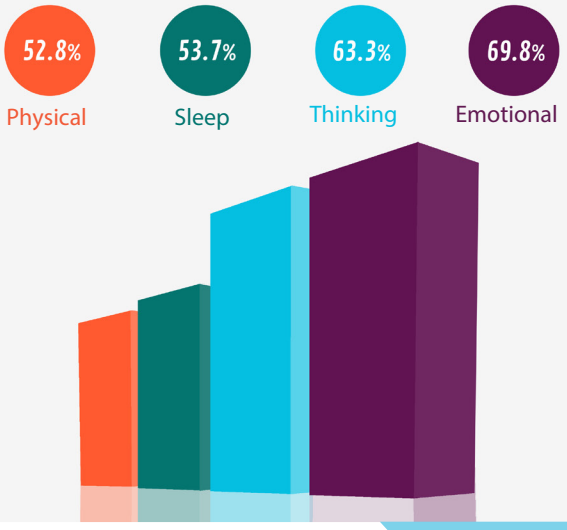
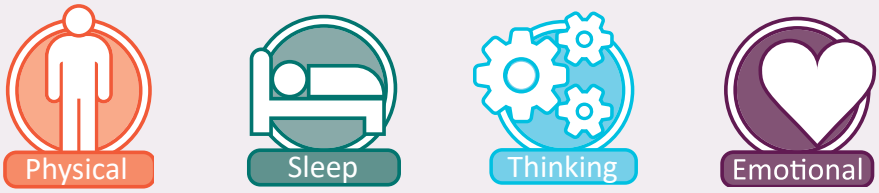
Do Symptoms Really Improve in One Week?

Average Overall Improvement



In one week, the average improvement for all symptom categories is over 50%. The emotional category improves the most at nearly 70%.



The following graphs to the right are a breakdown of the four categories shown:
Physical, Sleep, Thinking, & Emotional.
In them, we show the average improvement for the specific symptoms of each category.

Limitations

While we can resolve most symptoms in a week, some symptoms, such as vision, sleep difficulties, and some kinds of headaches, can take more time and dedication to resolve. At the end of each week we send each patient home with a detailed plan to continue making strides in their recovery.

After Treatment, if our patients need continuing therapy for certain symptoms, we refer them to specialists that will help them with their specific concerns. Some therapies we recommend are vision therapy, neuromuscular therapy, chiropractic care, massage therapy, and psychotherapy.

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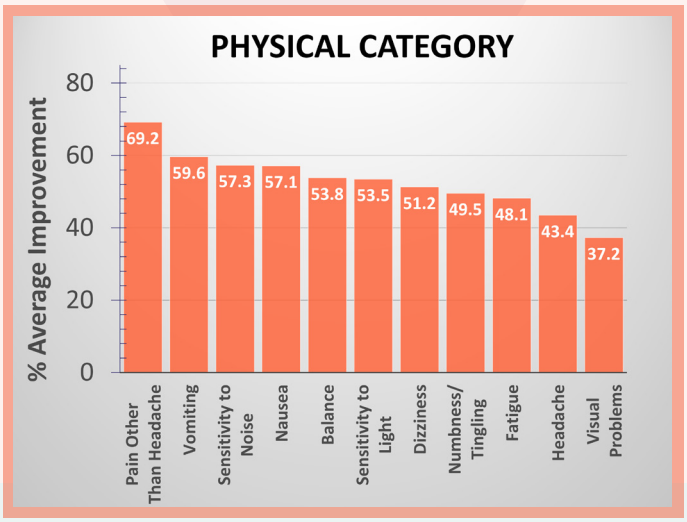
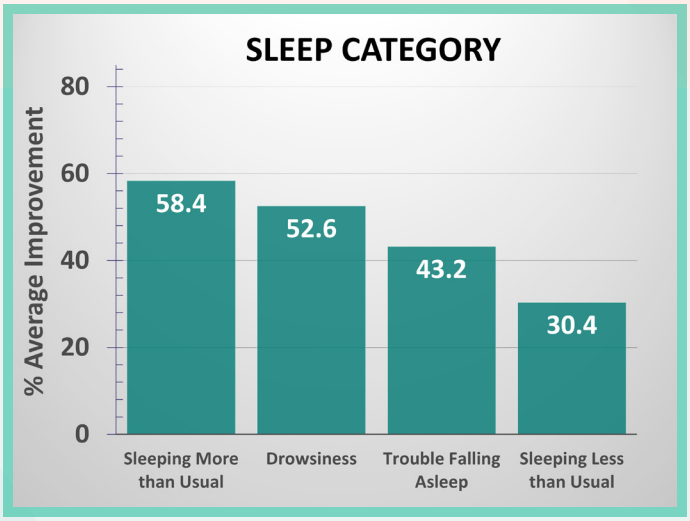


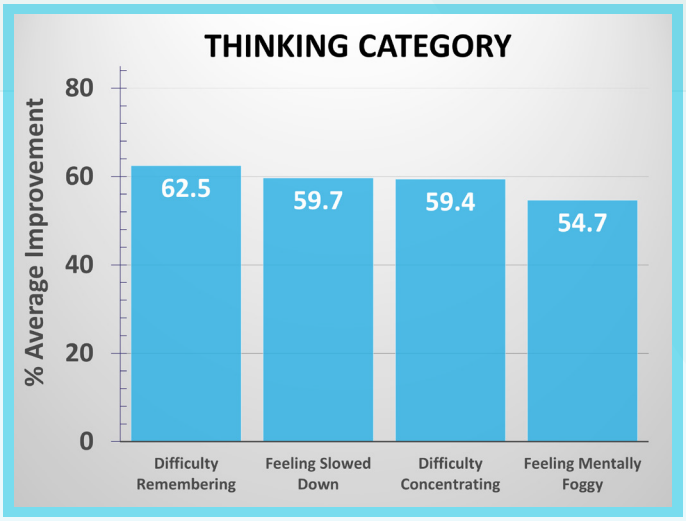
In the 11 symptoms measured under the physical category, pain other than headache improves the most. All symptoms improve around 40% or more in only one week.

The primary therapists addressing these symptoms include neuromuscular therapists, sensory motor therapists, and occupational therapists.

Of all symptom categories, sleep improvement varies the most between patients. Patients who slept more than usual before treatment saw a 58.4% improvement in rebalancing their sleep patterns.

Our occupational therapists and neuroscience practitioners empower patients through education to improve their sleeping habits during EPIC Treatment.



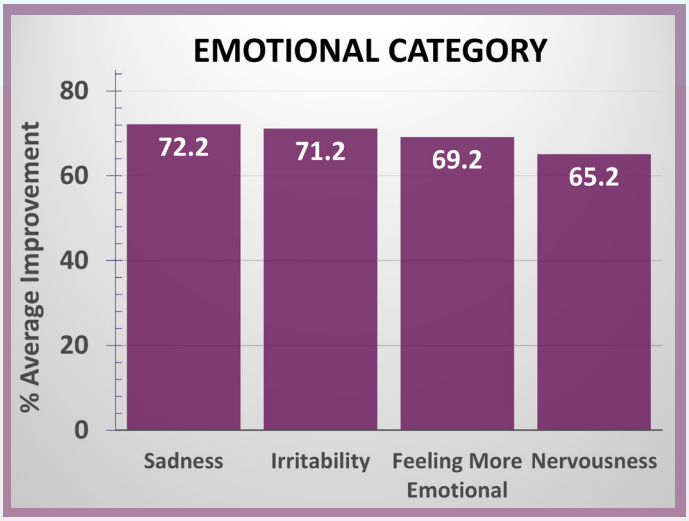


All symptoms in the thinking category improve by at least 50% over one week of EPIC Treatment.

Our whole team utilizes cognitive tasks in each specific therapy; however, it is primarily neurocognitive therapists who focus on improving cognitive function.

In the emotional symptom category, all symptoms improve more than 65%. Emotional distress is the top reported symptom from patients with post-concussion symptoms.

Patients often experience frustration from a lack of information regarding their brain injury. They are told that their emotional symptoms aren't correlated to their injury. At Cognitive FX we understand that emotional distress is very common in post-concussion symptoms. When patients see their fNCI results, they recognize that their injury is valid.



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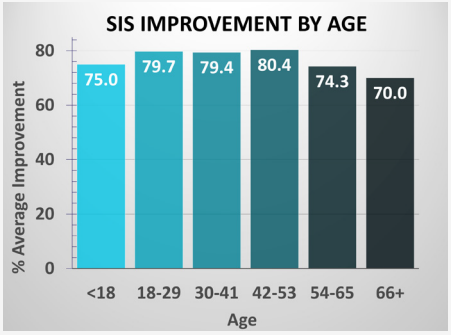
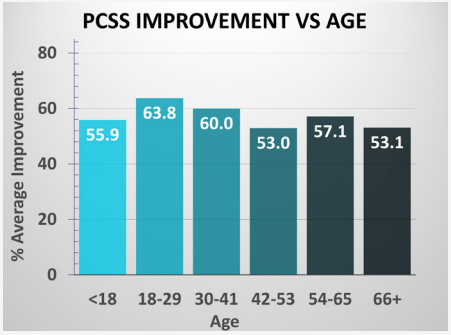
How Does Age Affect Recovery?

People of all ages have the same ability to recover. We see little variation between age groups, although the older population has a slightly lower improvement rate. All ages improve at least 70% on average after Treatment.



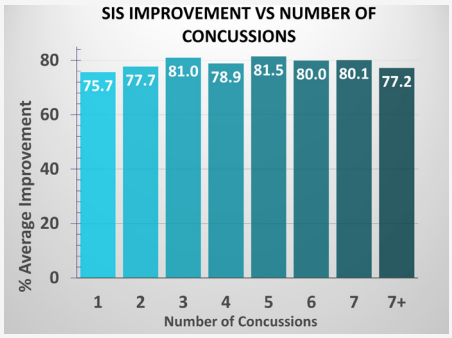


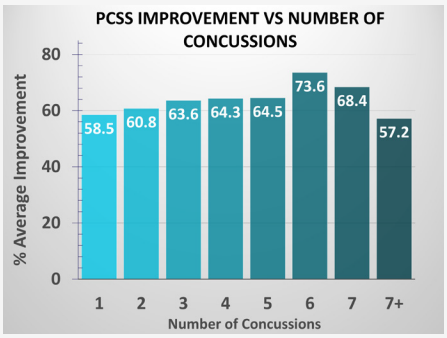


Do People Still Improve if They Have Had Multiple Concussions?

Patients experience significant improvement in symptoms regardless of the number of concussions they had. The number of concussions does not predict improvement.

Although symptoms are often worse with multiple concussions, it does not affect the ability to recover.





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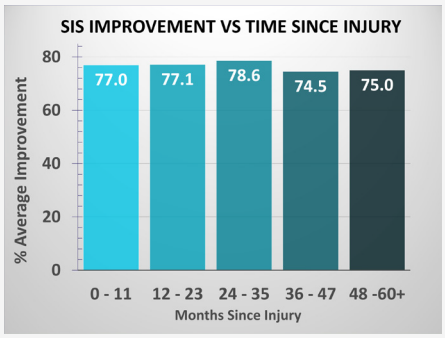
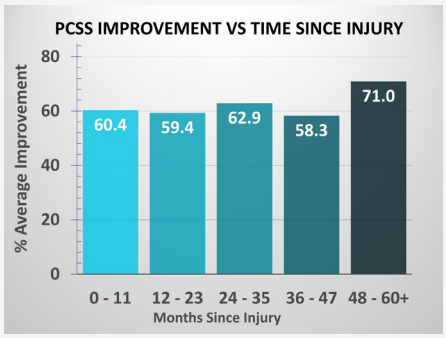
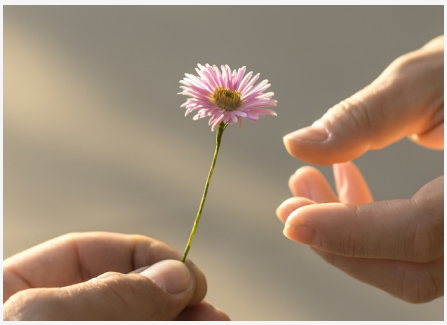
Do People Still Improve Even if Their Concussion or Brain Injury Was a Long Time Ago?

Regardless of how long it has been since injury, we see comparable improvement in both SIS and PCSS measures. However, patients with a long-term injury have more symptom improvement than more recent injuries.

We have treated patients as soon as three weeks after injury, but we have also treated patients who were injured for more than 65 years. It is never too late to get treatment!

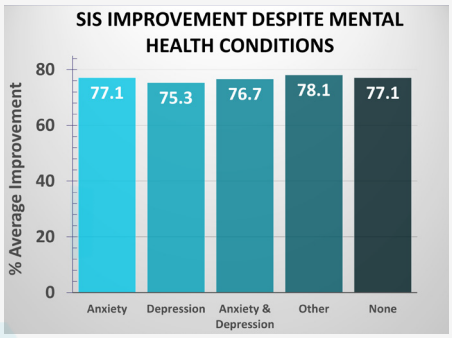


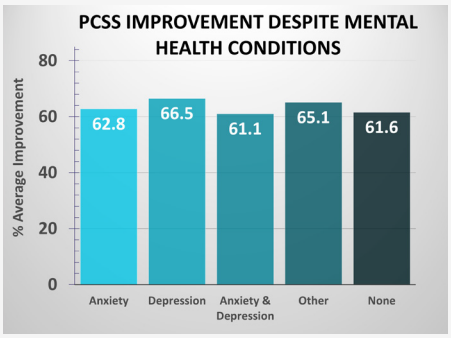




Do Depression, Anxiety, or Mental Health Symptoms Affect Treatment Outcomes?

Patients who suffer from anxiety, and depression, or other mental health symptoms show no difference in SIS and PCSS improvement compared to those without any mental health conditions. In fact, with EPIC Treatment, the emotional symptoms people experience from an injury improve 69% in one week.





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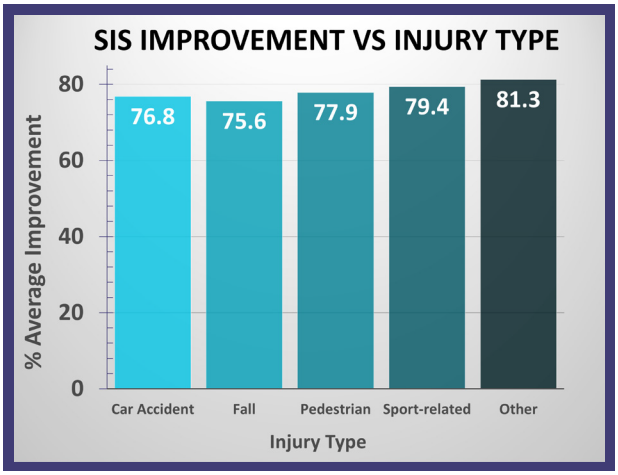
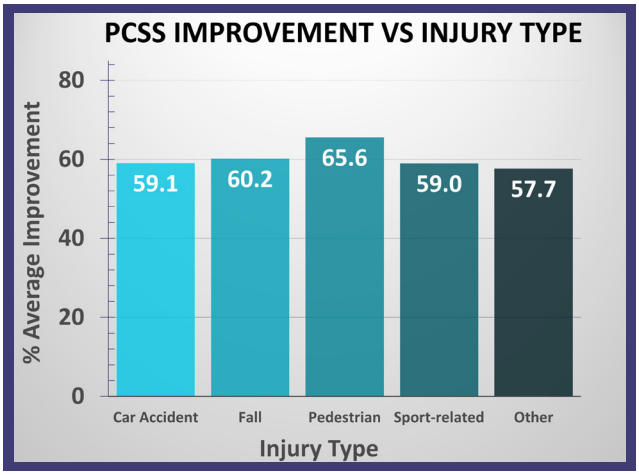
More Results & FAQs

Does the Mode of Injury Affect Treatment Outcomes?

It does not matter whether the injury is caused from sports, a car accident, a fall, or anything else. The rate of improvement is the same for all injury types.

Other types of injuries include domestic violence, stroke, carbon monoxide poisoning, loss of oxygen, and other trauma to the brain.

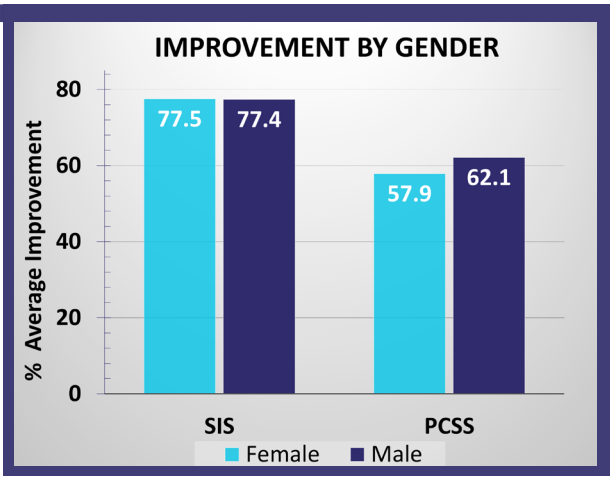




Does Gender Affect Improvement?

Recent studies have noted that women, on average, are more prone to receive a concussion and that they take longer to recover. Research on this topic is new, and no one has a current explanation for those findings. However, in our research, we do not measure any significant difference between male and female recovery; they both improve a similar amount in their SIS and PCSS score.

Our focus is to treat each patient individually, regardless of gender, by using each patient's brain scan (fNCI) to guide their treatment. By following this pattern, we see no difference in the ability for improvement between males and females.





Learn more about lasting concussion symptoms on our blog:
http://bit.ly/CFX-Concussions

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Third Party Research

In 2024, a team of Dutch researchers published a study to evaluate the effectiveness of EPIC Treatment at Cognitive FX. They analyzed the recovery of 64 patients over the course of six months following treatment at Cognitive FX looking at various symptom metrics alongside fNCI data to assess the treatment's impact on patient recovery.

Symptom Improvement

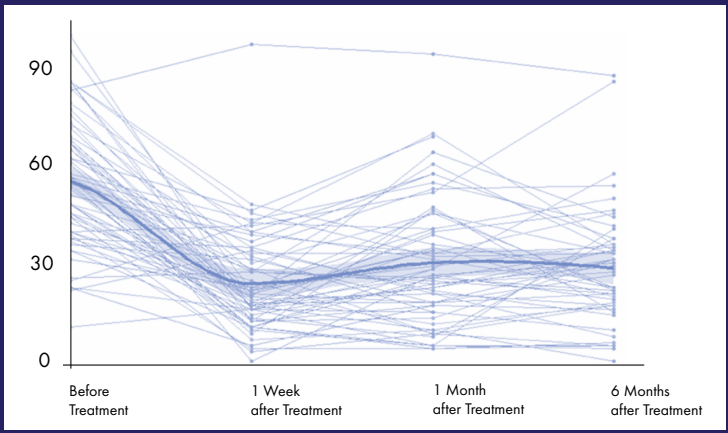
69%
1 month after treatment

77%
6 months after treatment

"On Symptoms burden, 69% of participants reported a meaningful improvement one month after treatment (SCAT5) and 77% six months after treatment."

Our findings offer independent evidence that intensive,multi-disciplinary care can meaningfully improve daily functioning for many with long-standing concussion symptoms."

—Dr. Esther van Doorn



SCAT -5

Symptoms were measured using the Sports Concussion Assessment Tool - 5th Edition (SCAT - 5). Patients rated 22 symptoms before treatment and 3 times after treatment. The average patient shows significant improvement in symptoms following EPIC Treatment,and that improvement continues to last 6 months after treatment.

Secondary Findings

Patients demonstrated significant improvements across **all measured areas of cognitive function**—from memory and focus to processing speed. Patients also saw improvement in anxiety, depression, fatigue and visual function. Only area that had mixed results was balance. Since the study we have invested heavily in new devices and therapies to better address balance dysfunction.

	1 Month	6 Month
Symptoms	↑	↑
Anxiety	↑	↑
Depression	↑	↑
Fatigue	↑	↑
Sleep Quality	↑	↑
Vestibular-Ocular Functioning	↑	↑
Neurocognitive Functioning	↑	↑
Participation		
Frequency	=	↑
Satisfaction	↑	↑
Balance	=	=

Source: Van Doorn, E., Oosterlaan, J., van der Naalt, J., Groenewold, R., Visser, A., Verheij, N., Klappe, E., Kool, A., Lindhout, M., Algra, P. R., & Königs, M. (2024). Cognitive FX treatment for persistent symptoms after a concussion: Observation of changes in functioning. Journal of Neuropsychology, 19(2), 110–138. https://www.tvnp.nl.

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Conclusion

At Cognitive FX, we have the research, the team, and the technology to bring hope and healing to anyone struggling with post-concussion symptoms and other brain injuries. Our vision is to advance the standard of care for post-concussion symptoms, improve EPIC Treatment based on new scientific findings, and help patients live a full life through treatment.

CFX will continue contributing research findings to the intellectual field. We strive to advance understanding of the brain, to expand the clinical applications of our research, and to educate individuals and physicians world-wide.

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Research Summaries

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Discovery of Therapy-Targeting Biomarkers for Post-Concussion Syndrome Using Functional Neurocognitive Imaging (2018)



Brain Disorders & Therapy

Epps and Allen, Brain Disord Ther 2018, 7:1
DOI: 10.4172/2168-975X.1000243

Research Article | Open Access

Discovery of Therapy-targeting Biomarkers for Post-Concussion Syndrome using Functional Neurocognitive Imaging

Caleb T Epps[1] and Mark D Allen[2,3]*

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[2]Cognitive FX, Provo, Utah, USA
[3]Notus Neuropsychological Imaging, Orem, Utah, USA

Abstract

Background: Post-concussion syndrome (PCS) occurs in a significant percentage of concussion patients. Functional MRI reveals irregular blood-oxygen level dependent signals in PCS patients. PCS biomarkers with functional predictive values have yet to be discovered and validated. Therefore, this study describes five PCS biomarkers and includes a description of their therapeutic application.

Methods: A neurocognitive imaging protocol was developed and a group of healthy control patients was used to generate a normative reference atlas. Biomarker candidate search was performed using an initial sample of PCS patients. Sample validation was applied to each biomarker using a new sample of PCS patients to assess sensitivities/specificities. A multivariate base rate analysis was performed using 132 new patients and a base rate cutoff matrix was constructed. An example of the biomarker's therapeutic application in a PCS patient is described.

Results: The five functional biomarkers included: Frontal Attentional System hypoactivation, Subcortical System hypoactivation, Visual System hyperactivation, Verbal System hypoactivation, and Frontal/Parietal System hyperactivation. Individual biomarker sensitivities and specificities are reported. Collectively, using the base rate cutoff matrix, a threshold using 3/5 biomarkers below the 10th percentile as the cutoff resulted in a suitable sensitivity (88%) and specificity (99%). The uses of these biomarkers were crucial in guiding the successful treatment of Patient A.

Conclusion: We report the discovery of five functional PCS biomarkers. We show an example of the therapeutic application of the five biomarkers in the successful treatment of PCS. These neuroimaging biomarkers serve to advance diagnostic capabilities and subsequent PCS rehabilitation efforts.

Keywords: Post-concussion syndrome; Functional MRI; Biomarker discovery; PCS rehabilitation; Mild traumatic brain injury

Introduction

Mild traumatic brain injury (mTBI) represents approximately 70% to 90% of traumatic brain injuries in the United States with an incidence of 600 in 100,000 people per year [1,2]. Though, the terms mTBI and concussion are often used interchangeably, concussion represents a variety of mTBI characterized by the absence of structural brain damage, though clinical manifestations may be similar [3]. Concussive symptoms typically resolve in 7 to 10 days (sports-related concussions) or within 3 months (non-athletes) [4]. However, approximately 33% of patients will have persistence of symptoms with 30% of those patients meeting post-concussion syndrome (PCS) criteria 6 months out from time of injury [5-8].

Clinically, there are imperfect standards for the diagnosis or treatment of PCS and, despite the given definition, diagnostic criteria are based on subjective symptoms and lack general agreement and specificity. Given this, there are even large differences in the estimated prevalence of PCS. Concerning treatment, PCS patients are traditionally prescribed rest, neurocognitive rehabilitation, education, and antidepressants, all without much evidence of success [9].

Standard structural clinical neuroimaging studies have no abnormal findings for the majority of PCS patients as the clinical presentations of PCS are thought to be caused by cerebrovascular dysregulation and neuronal dysfunction [10-12]. However, functional MRI (fMRI), which uses blood oxygen-level dependent (BOLD) signaling, has shown abnormalities in patients with PCS [13,14]. Therefore, fMRI is uniquely poised to serve an essential role in PCS diagnostics and therapeutics. However, fMRI requires two characteristics in order to become relevant in PCS management. First, a normative reference atlas, a reliable and accurate body of data from healthy subjects to which PCS patients can be compared, must be developed. Then second, PCS biomarkers with functional diagnostic predictive values must be discovered and validated.

As there is no wholly reliable standard in the diagnosis and management of PCS [15], the discovery and validation of PCS biomarkers using fMRI would be highly significant and could serve two primary functions. First, not only would reliable PCS biomarkers serve to accurately diagnose PCS, but they would also provide definitive thresholds used by clinicians. This would aid in determining return-to-play for athletes or return-to-work for non-athletes as well as provide data that meet typical standard of evidence criteria in legal settings [15]. Though the importance of this first function should not be understated, the second function of standardized PCS biomarkers would go beyond simply guiding a differential diagnosis. That is, they could serve to guide therapeutic management, as they would help answer not only if PCS pathology is present, but also provide information as to location and

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Received January 15, 2018; Accepted January 30, 2018; Published February 08, 2018

Citation: Epps CT, Allen MD (2018) Discovery of Therapy-targeting Biomarkers for Post-Concussion Syndrome using Functional Neurocognitive Imaging. Brain Disord Ther 7: 243. doi: 10.4172/2168-975X.1000243

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Neurovascular Coupling: A Unifying Theory for Post-Concussion Syndrome Treatment & Functional Neuroimaging (2017)



Journal of Neurology & Neurophysiology

Epps and Allen, J Neurol Neurophysiol 2017, 8:6
DOI: 10.4172/2155-9562.1000454

Review Article | Open Access

Neurovascular Coupling: A Unifying Theory for Post-Concussion Syndrome Treatment and Functional Neuroimaging

Epps CT[1] and Allen MD[2,3]*

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Received date: November 28, 2017; Accepted date: December 21, 2017; Published date: December 24, 2017

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Abstract

Post-concussion syndrome (PCS) occurs in a significant percentage of concussion patients and is defined as having a history of traumatic brain injury with persistence of three or more symptoms. Standard structural clinical neuroimaging studies show no abnormal findings for the majority of PCS patients as opposed to functional MRI, which often reveals irregularities in the blood-oxygen level dependent (BOLD) signal. This suggests that dysregulation of neurovascular coupling, which causes abnormal BOLD signals, plays a significant role in PCS pathology. However, compared to the pathophysiologic mechanisms occurring in acute concussion, the underlying neuropathophysiology of chronic concussive sequelaeor PCS is less understood, though becoming clearer with emerging research. We present a treatment approach grounded in the physiological theory presented here called Enhanced Performance in Cognition (EPIC), which has shown strong clinical success. Dysregulation of neurovascular coupling (NVC), along with disruptions in cerebrovascular reactivity (CVR) and autonomic nervous system (ANS) dysregulation are the targets of EPIC treatment. Success of the approach itself tentatively supports the hypothesis that these three features figure prominently in the neuropathophysiology of PCS. The aim of this report is to provide a theory of the underlying mechanisms of PCS pathology and its treatment that is in accord with the current corpus of research and explains the recent therapeutic success seen in PCS patient using the EPIC treatment. We propose a novel theory concerning the mechanisms by which NVC dysregulation is normalized. This includes focused, intense and repetitive neurocognitive challenges during post-exercise cognitive boost and the avoidance of intracerebral steal in the setting of restored and re-regulated CVR and ANS. It is intended that both the theory and treatment approach are presented explicitly enough to generate empirical studies with clear hypothetical predictions from the theory as well as clinical innovations with significant relevance to improve current practices.

Keywords: Post-concussion syndrome; Post-concussion syndrome; Autonomic nervous system; Cerebral blood flow; Cerebral vascular reactivity; Neurovascular coupling; Functional MRI

Introduction

Mild traumatic brain injury (mTBI) represents approximately 70-90% of traumatic brain injuries in the United States with an incidence of 600 in 100,000 people per year [1,2]. Though the terms mTBI and concussion are often used interchangeably, concussion represents a variety of mTBI characterized by the absence of structural brain damage, though clinical manifestations may be similar [3]. Concussive symptoms typically resolve in 7 to 10 days (sports-related concussions) or within 3 months (non-athletes) [4]. However, approximately 33% of patients will have persistence of symptoms with 30% of those patients meeting post-concussion syndrome (PCS) criteria 6 months out from time of injury [5-7]. PCS is defined as having a history of traumatic brain injury with persistence of three or more symptoms (i.e., headache, dizziness, fatigue, irritability and insomnia, difficulty in concentration or memory and intolerance of stress, emotion or alcohol) [8].

Standard structural clinical neuroimaging studies have no abnormal findings for the majority of PCS patients as the clinical presentations of PCS are thought to be caused by cerebrovascular dysregulation and neuronal dysfunction [9-11]. However, functional MRI (fMRI), which uses blood oxygen-level dependent (BOLD) signaling, has shown abnormalities in patients with PCS [12,13]. The BOLD signal detected in fMRI has been shown to be a reliable, indirect measure of neuronal activity in the form of vascular responsiveness to neuronal activity or neurovascular coupling (NVC). In the healthy brain, it has demonstrated a high level of consistency [14,15]. Therefore, when an abnormal BOLD signal is observed, the problem is with dysfunctional neural activation, dysfunctional NVC or both. Considering PCS, which by definition lacks gross structural injury, the observed BOLD abnormalities are more likely a result of dysfunctional NVC rather than dysfunctional neural activation and likely the predominant source of its symptoms. Further recent studies confirm a central role of NVC disruption in PCS [16-22].

In short, it is becoming increasingly clear that NVC alterations, along with cerebrovascular reactivity (CVR) disruptions and autonomic nervous system (ANS) dysregulation, play a significant role in PCS sequelae. The Enhanced Performance in Cognition (EPIC) treatment shows clear promise in the efforts to target NVC alterations (as well as CVR disruptions and ANS dysregulation) in the treatment of PCS [23]. However, a unifying theory describing how this treatment normalizes the pathologic state of PCS and is consistent with relevant research has yet to be proposed. Therefore, the aims of this article are two-fold. First, we propose a unifying theory of the pathologic state of

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We present a treatment approach grounded in the hysiological theory presented here called Enhanced Performance in Cognition (EPIC), which has shown strong clinical success.

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We propose a novel theory concerning the mechanisms by which NVC dysregulation is normalized. This includes focused, intense, and repetitive neurocognitive challenges during post-exercise cognitive boost and the avoidance of intracerebral steal in the setting of restored and re-regulated CVR and ANS. It is intended that both the theory and treatment approach are presented explicitly enough to generate empirical studies with clear hypothetical predictions from the theory as well as clinical innovations with significant relevance to improve current practices.

Epps C.T., Allen M.D. (2017) Neurovascular Coupling: A Unifying Theory for Post-Concussion Syndrome Treatment and Functional Neuroimaging. J Neurol Neurophysiol 8: 454. doi:10.4172/2155-9562.1000454

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Research Summaries

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Developing the Standard of Care for Post-Concussion Treatment: Neuroimaging-Guided Rehabilitation of Neurovascular Coupling (2017)



Abstract

Background: Emerging research proposes the imbalance between microvascular supply and metabolic demand as a contributing factor in the pathophysiology of mild traumatic brain injury. Prolonged effects on the dysregulation of neurovascular coupling may explain persistent symptomatic models such as Post-Concussion Syndrome.

Objective: Increased knowledge of what we refer to as neurovascular uncoupling provides a template for establishing a new concussion treatment standard in the assessment and therapeutic guidance of concussion.

Methods: The degree and localization of neurovascular uncoupling were statistically contextualized against a normative-based atlas in 270 concussed patients. Functional NeuroCognitive ImagingTM was used to establish pre-treatment benchmarks and guide neurotherapy. Conventional and functional neurocognitive imaging-directed measures were used to evaluate post-rehabilitative outcomes.

Results: Functional neurocognitive imaging was successful in identifying regions of Neurovascular uncoupling unique to each patient's brain and concussion profile. Longitudinal objective outcome measures demonstrated timely and lasting improvement of neurovascular coupling functioning in a significant majority of patients.

Conclusion: We present practice-based evidence supporting the clinical administration of functional neurocognitive imaging with particular efficacy in the neurorehabilitation of concussion. We advocate the reliability of functional neurocognitive imaging in assessing severity and localization of neurovascular uncoupling, and promote its use in the therapeutic guidance and neurorehabilitation of mild traumatic brain injury. We further support the continual exploration of other potential pathophysiological alterations resulting from concussion.

Wing B.H., Tucker B.J., Fong A.K., Allen M.D. (2017) Developing the Standard of Care for Post-Concussion Treatment: Neuroimaging-Guided Rehabilitation of Neurovascular Coupling. The Open Neuroimaging Journal, 2017, 11, 58-71

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Research Summaries

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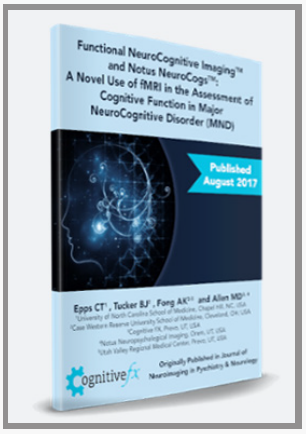
Functional NeuroCognitive Imaging and Notus NeuroCogs: A Novel Use of fMRI in the Assessment of Cognitive Function in Major Neurocognitive Disorder (2017)



Abstract

Background: Current diagnostic approaches to MND rely heavily upon the history of present illness and neurocognitive testing with functional neuroimaging playing a minimal role. The use of fMRI as a clinical tool has been limited due to the lack of a standardized protocol of cognitive testing appropriate for the scanning environment and lack of normalized data to which the individual patient can be compared. We therefore present Functional NeuroCognitive Imaging™ and Notus NeuroCogs™, a unique protocol for the assessment of MND.

Methods: The fNCI™ and Notus NeuroCogs™ protocol as initially performed on a population of 60 normative reference volunteers (32 Female, 28 Male) between the ages of 19-57 years old to produce a normative atlas. Four patients with clinical complaints of cognitive impairment underwent fNCI™ and Notus NeuroCogs™ imaging and were compared to the normative atlas.

Results: Structural imaging of Patient A-D alone could not confirm the diagnosis of MND. Patient A demonstrated severe cognitive deficits in 16 of 57 regions of interest (ROI), patient B in 26 of 57 ROI, patient C in 20 of 57 ROI, and patient D in 14 of 57 ROI. These results correspond with Moderate, Severe, Severe, and Moderate neurovascular uncoupling, respectively.

Conclusions: This report outlines the novel use of fMRI in the assessmentof MND and demonstrates its effective use in four patients. Specifically, we show the protocol's possible use as a clinical tool in characterizing the severity of cognitive impairment and early detection of cognitive impairment in patients at risk for MND.

Epps C.T., Tucker B.J., Fong A.K., Allen M.D. (2017) Functional NeuroCognitive ImagingTM and Notus NeuroCogsTM: A Novel Use *of fMRI in the Assessment of Cognitive Function in Major Neurocognitive Disorder. J Neuroimaging Psychiatry Neurol 2(1): 20-29*

Traumatic Brain Injury Alters Word Memory Test Performance by Slowing Response Time and Increasing Cortical Activation: An fMRI Study of a Symptom Validity Test (2011)


Traumatic Brain Injury Alters Word Memory Test Performance by Slowing Response Time and Increasing Cortical Activation: An fMRI Study of a Symptom Validity Test

Abstract

The Word Memory Test (WMT) is an established symptom validity test that relies on verbal memory performance to make inferences about "effort." Previous studies, using a functional MRI (fMRI) adaptation of the WMT with healthy controls, have shown that successful completion of the WMT relies on a widespread network of neural systems associated with high cognitive effort.

Additional studies using the same fMRI paradigm with patients with severe traumatic brain injury (TBI) suggest that increased activation of cortical regions associated with cognitive load are recruited to meet the cognitive challenges that the WMT places on a compromised neural system. Subjects

This study builds on previous findings as a result of highly uncommon circumstances in which fMRI data on the WMT task were made available from the very same individual both 1 year before and 1 year after sustaining a TBI.

Allen, M.D., Wu, T.C., & Bigler, E., (2011). Traumatic Brain Injury Alters Word Memory Test Performance by Slowing Response *Time and Increasing Cortical Activation: An fMRI Study of a Symptom Validity Test. Psychological Injury and Law, 4, 140-146.*

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Research Summaries

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MRI & Functional MRI (2012)



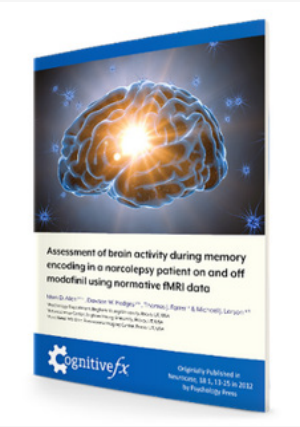
Abstract

Neuroimaging provides objective information about brain structure and function. In neurological and neuropsychiatric disorders, computed tomography (CT) and magnetic resonance imaging (MRI) are the standards.

The basics of CT and MRI are reviewed, with an emphasis on MRI, including quantitative methods used to assess the integrity of brain structure. MRI methods to assess the brain's connectivity using diffusion tensor imaging (DTI) are covered along with functional neuroimaging methods, in particular functional MRI (fMRI).

Bigler, E.D., Allen, M.D., Stimac, G.K, (2012). MRI and functional MRI. In Simpson, J.R.(Ed.) Neuroimaging in Forensic Psychiatry: From the clinic to the courtroom. Wiley-Blackwell Press.

Assessment of Brain Activity During Memory Encoding in a Narcolepsy Patient On and Off Modafinil Using Normative fMRI Data (2012)



Abstract

We present behavioral and functional magnetic resonance imaging (fMRI) findings of a 20-year-old female with narcolepsy who completed a standardized fMRI-adapted face memory task both 'off' and 'on' modafinil compared to a normative sample (N?=?38).

The patient showed poor recognition performance off modafinil (z =?-2.03) but intact performance on modafinil (z?=?0.78). fMRI results showed atypical activation during memory encoding off modafinil, with frontal lobe hypoactivity, but hippocampal hyperactivity, whereas all brain regions showed more normalized activation on modafinil.

Results from this limited study suggest hippocampal and frontal alterations in individuals with narcolepsy. Further, the results suggest the hypothesis that modafinil may affect brain activation in some people with narcolepsy.

Allen, M.D., Hedges, D.W., Farrer, T.J., and Larson, M.J. (2012). Assessment of Brain Activity during Memory Encoding in a Narcolepsy Patient On and Off Modafinil using Normative fMRI data. Neurocase, 18, 13-25.

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Research Summaries

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A Functional Neuroimaging Analysis of the Trail Making Test-B: Implications for Clinical Application (2011)



Recent progress has been made using fMRI as a clinical assessment tool, often employing analogues of traditional "paper and pencil" tests. The Trail Making Test (TMT), popular for years as a neuropsychological exam, has been largely ignored in the realm of neuroimaging most likely because its physical format and administration does not lend itself to straight forward adaptation as an fMRI paradigm.

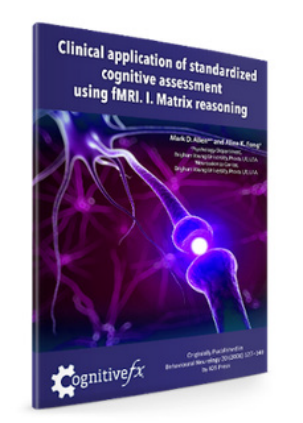
Likewise, there is relatively more ambiguity about the neural systems associated with this test than many other tests of comparable clinical use. In this study, we describe an fMRI version of Trail Making Test-B (TMTB) that maintains the core functionality of the TMT while optimizing its use for both research and clinical settings.

Subjects (N=32) were administered the Functional Trail Making Test-B (f-TMTB). Brain region activations elicited by the f-TMTB were consistent with expectations given by prior TMT neurophysiological studies, including significant activations in the ventral and dorsal visual pathways and the medial pre-supplementary motor area.

The f-TMTB was further evaluated for concurrent validity with the traditional TMTB using an additional sample of control subjects (N=100). Together, these results support the f-TMTB as a viable neuroimaging adaptation of the TMT that is optimized to evoke maximally robust fMRI activation with minimal time and equipment requirements.

Allen, M.D., Owens, T.E., Fong, A.K., Richards, D.R. (2011). A Functional Neuroimaging Analysis of the Trail Making Test-B: Implications for Clinical Application. Behavioural Neurology, 24, 159-171.

Clinical Application of Standardized Cognitive Assessment using fMRI (2008)



Abstract

Using standardized neuropsychological evaluations using tests like Matrix Reasoning, has been the standard for assessing cognitive impairment for many years.

Our research explores the application of an adapted version of the Matrix Reasoning Test, along with 5 other tests used in conjunction with fMRI, to establish an imaging technology called functional NeruoCognitive Imaging.

By creating a normative database, we have the ability to determine a range of expected "normal" function and activation, giving us s a scale for evaluating patient outcomes. This research was foundational to the approach we take here at Cognitive FX during EPIC Treatment.

Allen, M.D. & Fong A. (2008a). Clinical Application of Standardized Cognitive *Assessment using fMRI. I. Matrix Reasoning. Behavioural Neurology, 20, 127-140.*

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Cognitive FX makes no guarantee or representation of warranty (express or implied) regarding an individual's results from treatment participation or as compared to the aggregate results contained in this report. Results will vary from patient to patient, brain injury to brain injury.

Authors & Acknowledgement: Marci Johnson, Wil Desposorio, Anna Empey, Julia Kelemen, John Daines, Kaden Neuberger, Spencer Loong, Roman Kovtun, Kaylie Ferguson, Ty Carton, Dr. Mark Allen