Guidelines for Improving Memory Retention and Recovery in TBI Patients

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PROJECT DESCRIPTION

This document will discuss and thoroughly outline different methods to assist TBI patients in regaining and recovering their memory. The methods mentioned throughout to help patients recover or further improve their memory include brain exercises and brain games, physical exercise, nutrition, sleep, meditation, and active rest, and minimizing behavioral impairments. Each method is specific to achieving its own goal however, traumatic brain injury carries a different level of severity which then alters the solution under each method as well as the patient's willingness to engage in recovery which is something to keep in mind while the initial assessment occurs.

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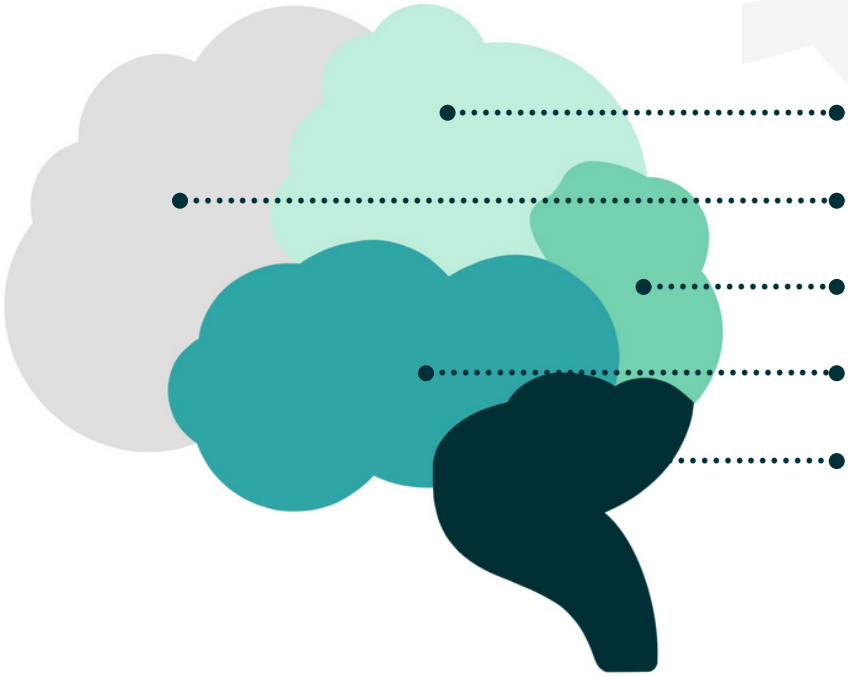

BRAIN EXERCISES AND GAMES

This section will discuss how brain exercises can be used to improve memory in TBI patients and specifically detail how this would look. These exercises can be used by all TBI patients and would be particularly useful for patients with limited mobility. While these exercises are usually done at clinics with professional supervision, it would be relatively simple for them to be practiced by the patient at home, as they are usually done on a computer. The following three brain exercise programs have led to great improvement in memory in TBI patients and should be implemented to optimize the recovery process. Additionally, please ensure that the patient is able to endure using the electronic screens without implementing further damage to their brain.

USING VIRTUAL REALITY[7]

- 10 virtual reality sessions are completed, each having its own unique task with the tasks becoming more difficult each time.
- The patients are able to practice real-life scenarios, like brushing their teeth and going to the grocery store, which increases confidence in real life.
- Patients are inclined to do the exercises due to the excitement around VR.
- The therapist is only involved in explaining each session's procedure and assessing the results of each session.
- Through the PASAT tests, it is shown that sustained attention and working memory are improved as they progress through more VR training.

WORKING MEMORY TRAINING[13]

- Patients participate in training via the CogMed RM program for about 30 minutes a day, 5 days a week, for 5 weeks with each session consisting of 15 trials of 8 exercises. During the training sessions, the patient is supervised by a training aid.
- The difficulty level of the exercises is determined on an individual basis so that each patient is working close to their own working memory limits and the program has built-in rewards. Once a week the patient will meet with a training coach who is certified in the CogMed program that will provides support to the patient.
- Patients showed improvement in working memory in general, but especially in the part of working memory that is responsible for the storage and maintenance of verbal information (VSSP).

SEMANTIC MEMORY TRAINING[5]

- The specific program used is the Intensive Semantic Memory Training (ISMT) which uses verbal comparison to look at the semantic connections within the patient's knowledge. This is done by the therapist saying a word and asking the patient to say every word they associate with that word. The therapist then moves on to another category word once the patient can no longer come up with any more words for the current category word. After the patient has come up with words for a few category words, the patient will connect words in different categories to each other.
- Training consists of eight 1 hour sessions that start with more basic material and advance to more complex and obscure concepts.

PHYSICAL EXERCISE

This section will cover some simple, yet effective physical exercise regimens that can be used in the cognitive rehabilitation of TBI patients. The incorporation of physical exercise into a TBI rehabilitation program is essential, as cognitive improvements are directly linked to cardiorespiratory fitness via the regulation of dopamine[3]. Aerobic exercises, such as swimming, cycling, and treadmill exercise, are specifically effective in improving cognitive performance as they are shown to lead to hippocampal enhancement[8] The following guidelines should be the goal in order to maximize cognitive improvement.

GOAL ONE

Exercise for 120 minutes or more every week.

- Achieving 120 minutes-per-week allows the patients to gain the benefits on cognitive performance from improved cardiorespiratory fitness[3].
- Regular exercise also has other possible benefits including minimized depression, improved sleep, and community involvement[9].

GOAL TWO

Each exercise session should last at least 45 minutes and include a warm-up, at least 30 minutes of aerobic exercise, and a cool-down.

- Aerobic exercises are any that provide cardiovascular conditioning and include running or walking on a treadmill, cycling, swimming, or going for a brisk walk.

GOAL THREE

Meet the intensity goal of 60-80% of your maximum heart rate for more than 20 minutes during aerobic exercise.

- Sustaining this heart rate range during an aerobic workout is shown to improve cardiorespiratory endurance, helping achieve the end goal of improved cognitive performance[15]
- Make sure the patient has access to a way to track their heart rate throughout the exercise. There are affordable options such as various FitBit models that retail around $30 USD

ADDITIONAL NOTES

- On days when patients are feeling too overwhelmed emotionally or tired, they can perform yoga exercises. Since yoga engages both the mind and the body, it can be very beneficial to TBI patients in efficiently healing the body. Yoga also focuses on quieting the mind and focusing on your body's movements, so it can help relieve stress and anxiety.
- It can also be recommended to patients to begin incorporating small amounts of strength training into their workouts as they progress. If the patient is having a lot of intense headaches or migraines, be wary as strength training can aggravate the headaches.

NUTRITION

Nutrition plays an integral role in recovering memory in TBI patients. This section will cover recommended nutritional guidelines as well as a sample week of the diet that TBI patients should follow in order to optimize memory recovery post-injury. Ketosis is a state in which the body runs off of ketones rather than primarily carbohydrates. Ketogenic diets have been found to have neuroprotective and therapeutic potential in recovering cognitive function in rats with TBI's by reducing the levels of cellular apoptosis[11]. However, the ketogenic diet can be relatively difficult for patients to maintain over a long period of time. The Mediterranean diet has also shown potential in aiding memory recovery as it emphasizes foods that contain neuroprotective compounds such as B-vitamins and poly-unsaturated fatty acids[12]. The list below outlines specifics of the Mediterranean Diet and Ketogenic Diet.

THE MEDITERRANEAN DIET

- 1-2 times a week: Poultry, egg, and dairy products.
- More than 3 times a week: Fish, seafood, foods rich in Omega-3 Fatty Acids
- Daily: herbs, healthy fats (unsaturated), fruits, legumes, and vegetables.
- Minimize red meat and sugar intake.

	Monday	Tuesday	Wednesday	Thursday	Friday
Breakfast	greek yogurt, strawberries, chia seeds	oatmeal with blueberries	omelet with mushrooms and tomatoes	yogurt with fruit and nuts	eggs and vegetables with toast
Lunch	sandwich, hummus, vegetables	caprese zucchini noodles with olive oil	sandwich with cheese and vegetables	quinoa salad with chickpeas	stuffed zucchini with pesto, cheese, turkey
Dinner	tuna salad with greens and olive oil, fruit salad	feta, olives, chicken, farro, tomato salad	mediterranean lasagna	salmon with brown rice and vegetables	lamb, salad, and baked potato

THE KETOGENIC DIET

- Animal Products for fat: Fish, Full-fat cheeses, egg yolks, greek yogurt, heavy cream, butter, ghee, bacon, deli meats, and fatty beef or steak.
- Plant-based fats: Avocados, Nut oils, nuts, and olives.
- Protein Sources: Eggs, tofu, lentils, beans, chickpeas, black soybeans, and all meat sources listed in (A).
- Carbohydrates: Vegetables should be the primary source of carbs and fiber, fruit intake is minimized.

	Monday	Tuesday	Wednesday	Thursday	Friday
Breakfast	scrambled eggs, lettuce, avocado	coffee, hard-boiled eggs	cheese and vegetable omelet with salsa	almond milk protein smoothie	fried eggs, bacon, side of greens
Snack	sunflower seeds	macadamia nuts	greek yogurt, pecans	two hard-boiled eggs	walnuts and berries
Lunch	spinach salad, salmon	tuna salad, tomatoes	sashimi and miso soup	chicken, salad, cheese	burger, avocado, salad
Snack	celery, guacamole	roast beef, cheese roll-up	protein smoothie	cheese, bell peppers	celery, almond butter
Dinner	pork chop, cauliflower, red cabbage	meatballs, zucchini noodles, cream sauce	chicken with asparagus and mushrooms	shrimp with lemon butter sauce, asparagus	tofu, cauliflower rice, peanut sauce, broccoli

SLEEP, MEDITATION, AND ACTIVE REST

Sleep is an integral part of the healing process after a TBI is sustained. Additionally, sleep may help clear waste from the injury site via improved activation of the glymphatic system[14]. Active rest may also play a role in the healing process. TBI patients who engaged in regular active rest after their injury showed substantial improvements in cognitive function[4]. Meditation can also be utilized as a mechanism of memory improvement. Meditation may help improve concentration and avoid depression thus leading to more optimistic attitudes and cooperation during recovery[2].

SLEEP[10]

- Aim for 8 hours of sleep per night
- Avoid blue light exposure 1-2 hours before bed
- Avoid stressful situations 1-2 hours before bed
- Avoid napping during the day in order to keep a regular sleep schedule

MEDITATION

- Within 10 to 12 weeks of practice, TBI patients have reported improvements in their quality of life, memory, depression, and regulation of attention .
- It is also widely known that long-term practice of meditation has been found to improve overall mood, emotional stability, organization, decision[2] making, and problem-solving, and also lower fatigue and anxiety.
- Patients should participate in meditation programs that focus on breathing exercises, guided visualization, and reframing the TBI through acceptance.
- The recommended form of meditation for beginners is guided meditation. This is when the state of relaxed concentration is led by another party. Guided meditation encourages the participant to direct their attention to a single object, sound, or sensation such as the sound of your breath or the coolness of the ground.
- An individual meditation session can last anywhere from a few minutes to several hours. It is encouraged for the patient to initially meditate for at least 10 minutes at a time, once a week. As the patient becomes comfortable with the experience, they can increase the length and frequency of mediation as they progress.

ACTIVE REST

- Follow up your workout with active rest! Active rest is when you are resting while including cognitive stimulation such as listening to music, scrolling through social media, or even playing video games[16].
- This is important as it provides sensory stimulation that replicates the mild disruptions and distractions that are present in daily life. Patients who subject themselves to it regularly are more likely to succeed in reintegrating themselves into “normal” life and have a 73% increase in cognitive performance[4].

MINIMIZING BEHAVIORAL IMPAIRMENTS

37%-71% of mild to moderate TBI patients develop behavioral changes or impairments such as anger, depression, agitation, verbal and physical aggression and as a result of this, there is a sense of emotional stability that is now needed[6]. Other than emotional stability, there is also an unintentional social separation that occurs more times than not from these behavioral changes. With social isolation, there could be an added risk of developing Alzheimer's and more forgetfulness from not socializing. There is an added strain or stress that develops when placed in social situations causing anxiety. Oftentimes TBI patients will develop attention deficit disorders, which play a large role in the declination of memory, which is why cognitive rehabilitation, the way the patient thinks, the memory, the expression/behavioral changes, is first assessed[1]. In order to start cognitive rehabilitation, a neuropsychological assessment is needed and a scale is used to determine the patient's mental function. Since the mental function varies in every patient, it will need to be administered on an individual basis so cognitive rehabilitation could be split up into separate areas such as restorative and compensatory[1]. The way the patient is acting and communicating after a TBI injury will help determine which part of the brain has been most impaired to narrow down the targets of restoration.

COGNITIVE TRAINING AND PSYCHOTHERAPY

- Cognitive training and talk therapy will allow the patient to practice language skills and social-behavioral/cues with a professional to get more comfortable with social cues and relieve stress when in a larger social setting[6].
- This will help with an emotional adjustment to further improve communication skills[1].

MUSIC THERAPY

- Listening to music such as classical will further adjust the emotional stability and improve the overall mood and anger.

PHARMACOTHERAPY

- Drug therapy could potentially manage behavioral impairments such as using antidepressants[6].

NONINVASIVE BRAIN STIMULATION

- Based on where the TBI is located in the brain, sending or redirecting signals to the brain could help to positively impact the mood, language, and working memory[1].

INTERNET MATERIALS

Specialized computer and other internet training materials: The patient will practice with visualizations on a computer to help rehabilitate the communication skills.

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GUIDELINES FOR IMPROVING MEMORY RECOVERY AND RETENTION IN TBI PATIENTS

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These methods include brain exercises and brain games, sleep, and meditation, minimizing behavioral impairments, nutrition, and physical exercise. Each method creates a different impact on the overall goal of recovering memory loss and should be administered by the medical professional. This document is intended for patients with mild-moderate traumatic brain injury (TBI).

SLEEP, MEDITATION, AND ACTIVE REST

1. **Sleep**
- Aim for 8 hours of sleep per night
- Avoid blue light exposure and stressful situations 1-2 hours before bed
- Avoid napping during the day

2. **Active rest**
- Resting while engaging in something that is enjoyable and stimulating
- For example: listening to music, playing video/computer games, and reading

3. **Meditation**
- Find a quiet, calming place to sit
- Set a time limit
- Be mindful of your body by sitting in a position you can hold for the duration of your time limit
- Close your eyes and focus on your breathing
- Let your worries go and relax. Focus on the environment in that moment
- When the time is up, slowly open your eyes. Reflect on how the meditation made you feel both physically and mentally

MINIMIZING BEHAVIORAL IMPACTS

The first step in reducing or improving behavioral impairments is to begin looking at cognitive rehabilitation, the way the patient thinks, the memory, the expression/behavioral changes. In order to start cognitive rehabilitation, a scale is used to examine mental function. The mental function will vary and cognitive rehabilitation will occur according to the personal needs of the patient.

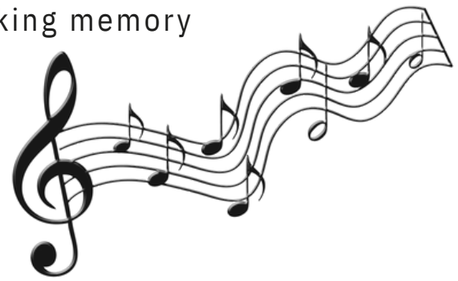
1. **Brain training or talk therapy**
- Practice language and social/behavioral skills
- Helps with an emotional adjustment to further improve communication skills

2. **Computer and other internet training materials**
- Practicing with visualizations to help rehabilitate communication skills

3. **Music therapy** to further adjust the emotional stability and improve overall mood

4. **Drug therapy** via primary physician to further manage behavioral impairments

5. **Brain stimulation**
- Will redirect or send signals to the brain that could positively impact the overall mood, language, and working memory



PHYSICAL EXERCISE

Physical exercise should be integrated into regular life gradually and ensure that before increasing intensity, it is discussed with the physician.

1. **Exercise for 120 minutes or more every week**
   - Allows the patient to obtain the benefits on cognitive performance from improved cardiorespiratory fitness
2. **Exercise sessions should last at least 45 minutes** and include a warm-up, at least 30 minutes of aerobic exercise, and a cool-down.
   - Aerobic exercises are any that provide cardiovascular conditioning and include running or walking on a treadmill, cycling, swimming, or going for a brisk walk.
3. **Meet the intensity goal of 60-80%** of your maximum heart rate for more than 20 minutes during aerobic exercise.
   - Maximum heart rate can be calculated by subtracting your age from 220. The 60-80% range will then be 0.6*(220 - your age) to 0.8*(220 - your age).
4. **Additional notes:**
   - On days when you are not able to work out, try participating in yoga. Since yoga engages both the mind and the body, it can be very beneficial to TBI patients in healing the body. Yoga also focused on quieting the mind and focusing on your body's movements can help relieve stress and anxiety.

COGNITIVE EXERCISE

1. **Using virtual reality to perform everyday tasks**
   - 10 virtual reality sessions will be completed, each having its own unique task like buying one item from the grocery store with the tasks becoming more difficult each time.
   - Good practice of real-life scenarios, like brushing your teeth and going to the grocery store, which will make you more confident when you do them in real life.
2. **Working memory training program**
   - Training will be about 30 minutes a day, 5 days a week, for 5 weeks, each session consisting of 8 exercises with 15 trials per exercise.
3. **Semantic memory training program**
   - Training will consist of eight 1 hour sessions that start with basic material and advance to more complex and obscure concepts.

NUTRITION

Nutrition is a crucial aspect of overall physical health and can have a large impact on cognitive health. Major dietary changes should be discussed with the patient's primary care physician in advance.

1. **The Ketogenic Diet:** This diet should consist of about 75% fats, 10-30% protein, and no more than 20-50 grams of carbohydrates per day.
   - Animal products for fat: fish, full-fat cheeses, egg yolks, greek yogurt, heavy cream, butter, bacon, deli meats, and fatty beef.
   - Plant-based fats: avocados, nut oils, nuts, and olives.
   - Protein sources: eggs, tofu, lentils, beans, chickpeas, black soybeans, and all meat sources listed above.
   - Carbohydrates: vegetables should be the primary source of carbs and fiber, fruit and simple carbohydrate intake are minimized.
2. **The Mediterranean Diet:**
   - 1-2 times a week: poultry, egg, and dairy products.
   - More than 3 times a week: fish, seafood, foods rich in Omega-3 Fatty Acids
   - Daily: herbs, healthy fats (unsaturated), fruits, legumes, and vegetables.
   - Minimize: red meat and sugar intake.