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Research Article

Recovering Cognitive Deficit in Epilepsy: Innovative "BrainNext" Tools Program at Epilepsy Foundation, India

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Abstract

Introduction: Epilepsy is observed at any age from a newborn infant to elder adults, having long term effects on physical, psychological and cognitive capacity of the affected individual [1,2]. Epilepsy causes significant cognitive impairment and the longest YLD as compared to other neurological population [3,4]. This study focuses on 19 months systematic cognitive rehab program for 152 epilepsy patients, using "BrainNext", tools, the concept based on synaptic plasticity [3].

Materials and Methods: Based on clinical history of Epilepsy Patients N = 152, ages 2.6 to 45 were tested and given memory and cognitive training program using innovative Global and National award winning "BrainNext" tools at "Epilepsy Foundation", India. Patients belonged to varied socio-economic, educational and cultural backgrounds. The caregiver was trained, covering 2 to 3 cognitive domains at a time as applicable with certain time duration follow-ups for 4 to 5 months. To measure the progress, 1 to 10 rating scale was used, score 1 as 10% and 10 as 100% recovery. 0% was set as the baseline condition for all.

Results and Discussion: Responses evaluated at each follow-up, Caregiver support and regular follow-up. Patients N=66 with Caregiver support and regular follow-up for 4 to 5 months improved memory, cognitive and behavior responses > 45% to 80% from the baseline condition, amongst 26 improved up-to caregiver's satisfaction needed no further visits. Patients N = 80 with moderate caregiver support, intermittent gaps and irregular follow-up for 9 months improved memory, cognitive tasks and behavior with 25% to 55% from the baseline condition, excluded N=6 patients with < 15 days training.

Conclusion: "BrainNext" award winning tools are safe, durable, easy to use, yield positive results apart from YLD of patient. Besides uncontrolled seizures and cognitive disability the patient and caregiver could follow cognitive rehab with own pace, without barrier, improving cognitive learning capacity, lessening caregiver's burden. Patients having developmental disorders built sensory capacity for pain and temperature and the sense of "cautiousness" for the first-time. Overall patients improved in speech, attention, concentration, stability, emotional expression and motor control improving quality of life.

Keywords: *Epilepsy; Seizures; Memory; Cognitive; BrainNext; Neurorehabilitation*

Abbreviations

UMACE: Universal Memory and Cognitive Exam; YLD: Years Lived with Disability; ADHD: Attention Deficit Hyperactivity Disorder; TBI: Traumatic Brain Injury

Introduction

Epilepsy, seizure disorder is seen across large number of populations in their productive ages. Varied reasons are observed behind developing seizures in neonatal stage to adults (Table 1). The duration of illness while compared between neurological disorder groups such as Vertigo, Migraine, Stroke, TBI, Parkinson's and rare brain diseases the author found that Epilepsy population has the longest YLD having significant population under moderate to severe cognitive disability [3,4].

Epilepsy demonstrates significant impact on the cognitive abilities but simultaneously affects psychological wellbeing, academic and learning experience, disrupts career opportunities, faces social stigma, yet leaving maximum population in despair with lack of self-awareness regarding the condition [1,2]. Lack of awareness regarding epilepsy symptoms and conditions, long-term medicine dependency and yet many questions unanswered; the patient and the caregiver seem to be in distress. Low-socio economic conditions, ignorance, lack of accessibility for treatments drag more patients into disability criteria.

The research in neurology population, (with comparative studies between Vertigo, Epilepsy, Migraine, Stroke, Parkinson's, TBI, rare brain diseases excluding Alzheimer's and varied dementia profiles), with standardized memory and cognitive screening tool "UMACE" Universal Memory and Cognitive Exam (2011 - 2013) showed significant memory and cognitive impairment in patients with Epilepsy similar to those suffering with Alzheimer's and Dementia [3,4].

While working on the "UMACE" neurological patient's study in adults the author observed similar cognitive and behavior deficit in neurological patient population below 18 years and tried to find the answer to regain cognitive capacity, led to the development of 'BrainNext" 500+ memory and cognitive tools (2011-2015). The "BrainNext" tools are developed on the medical neuroscience concept of Synaptic Plasticity, by finding the weakness in information processing for the neuron and then filling the information gap by feeding nano information to the weak neurons to ignite effectively. As the neurons become capable to handle nano information, they start becoming healthier, gaining more information processing capacity day-by-day and producing healthy electrical signals to strengthen and normalize chemical signals and to generate effective synaptic transmissions. Thus, creating more neural connections helping neurons to receive, process and deliver desired sensory-motor reaction.

Based on the study of > 2000 varied neurology populations with "BrainNext" tools between 2011 - 2017 the work expanded into other cities in India. The Epilepsy Foundation work started on a large scale connecting with Indian govt. National health Mission Program at District, Sub-District and Rural Civil Hospitals. Several major District Civil Hospitals in Maharashtra State in India, having "Memory Clinics" under mental health department adopted "BrainNext" and "UMACE" tools helping patients to improve memory and cognitive deficit. The application of "BrainNext" tools extended for neurodegenerative diseases at Sancheti Hospital, Pune India for patients having varied dementia profiles: the concept proved to be significantly helpful for memory recall and gaining cognitive capacity within weeks' apart from YLD and severity of the disease.

The successful rehab outcome for > 125 epilepsy patients at Epilepsy Foundation India, "BrainNext" was recognized with 1st ever National award as - "Neurorehabilitation Innovation of the Year Award 2019" by Indian Academy of Neurology, supported by IFNR and WFNR, was given a choice of treatment in the above said clinics, hospitals, NGOs etc.; the concept is based on "Synaptic Plasticity" [3,5-9].

The ongoing research and clinical practice in neurological disabilities the researcher found that Epilepsy exhibits irregular pattern of electrical signals impacting chemical signal activity and action potential of firing of neurons normally, which is different than other cognitive impairment without seizures. The "BrainNext" tools work on re-structuring neuronal connections normalizing both signals successfully.

The research article illustrates Patient-centered Memory and Cognitive rehabilitation, a step-by-step systematic 19 months program for varied Epilepsy profile patients N = 152, ages between 2.6 to 45 years using "BrainNext" tools from July 2018 to February 2020. The program had many treatment combinations with varied populations those included Arabic patients from Gulf countries, multi-lingual Indian patients and the caregivers using "BrainNext" tools uniformly to provide the best support for the patient following specific time intervals.

Materials and Methods

Materials

"BrainNext" 500+ memory and cognitive brain exercises tools are divided into 18 Sets is a copyright of the author. The product is designed between 2010 to 2015 when the author was developing a memory and cognitive impairment screening tool for dementia – "UMACE" (standardized in 2015 with research funding from Australia) [4]. To find the answer for the deficit diagnosed with "UMACE", the author was motivated to develop "BrainNext". In the clinical practice the author was observing similar cognitive impairment among all age groups, children to elderly though each patient exhibited different neurological condition and based on these observations the design and development of "BrainNext" tools - cognitive exercises was completed between 2011 to 2015, which has found to be useful for mild to severe cognitive deficit in all age groups.

The exercises are in a form of laminated sheets, cloth and acrylic material. The tools material is safe, durable and affordable having no side-effects, nor having any kind of physical invasion and are manufactured locally.

It is applicable to all neurologically disabled population from 2.6 years to elderly, mild to severe conditions.

For severe patients, and children below 2.6 years special tools are designed and added as necessary.

"BrainNext" exercises encompass almost all cognitive functions that any human brain may perform, treating all memory and cognitive deficit under one umbrella considering common cortical structures and sensory inputs and proposed damage to the neuronal circuits for all humans and not separating it on the bases of the names of the disorders. The principle feature based on "Synaptic plasticity" works on feeding nano-information for the weak neurons to retrieve its action potential for better depolarization at the presynaptic levels and to improve postsynaptic terminals to multiply receptor binding expanding inter connections, thus helping to re-gain its original capacity to process sensory information and controlling motor actions accordingly.

The neuron's action potential induces positive action at post synaptic terminals balancing neurotransmitter's activity and contributes to correction in behavior. As the brain rehearses and regains its capacity to acquire the lost information, the gaps in follow-ups or having mild to severe seizure episodes during cognitive rehabilitation program do not affect the acquired cognitive learning and behavior responses. As the presynaptic and postsynaptic synchronization establishes with "BrainNext" exercises it is observed that there is no loss of processed information and/or loss of memory retention and the brain does not go backward in learning process. After three follow-ups at the end of 1 and half months and systematic gaps in between further training program do not create information loss or make the brain stagnant, but the brain continues to acquire new information on its own and positive improvement continues. Apart from the percentage of deficit and the YLD of an individual patient, >10% improvement is seen from the baseline condition within first 15 days.

"BrainNext" has been useful in finding mild deficit in Normal population and has been used for > 950 normal school children below 10 years of age to detect slow learners with varied LD, Autism and ADHD related cognitive deficit.

Special feature

Apart from rehabilitation the "BrainNext" tools have been designed for testing and training purposes to address the scarcity of concerned professionals across the Globe. Each "BrainNext" Set has a "Testing Page" that any non-clinical person can use with little training to find out deficit in the affected person and can use the information booklet provided with each set for further training. Individual patients are given mixed set of cognitive exercises to achieve the best results with patient-centered treatment. Any number of Sets can be purchased by individual practitioners, clinics/disability care homes/nursing homes/NGOs/hospitals where multiple patients are treated and trained by a group of professionals at a time, either ways the treatment is affordable and accessible with similar efficacy.

Methods

The patient population, 72 Male and 80 Female from 2.6 years to 45 years age had a history of seizures from mild to severe with comorbid conditions (Table 1). The reasons for seizure episodes were different for each patient yet sharing few similar baseline medical conditions such as having developmental deficit, birth trauma, hypoxia, high temperature and fall/hit along with other complications. All 152 patients had epilepsy as a common clinical factor with different seizure patterns. The duration, severity and intensity of seizures was different for each patient. Table 1 explains the types of seizures, EEG readings, clinical and general history about each patient, MRI readings for each patient as diagnosed for 152 patients and the reasons found in the history of each of the patient.

Age	Types of seizures (EEG readings)	MRI readings	Duration of seizures and Intensity	Reasons/triggers for seizures (General and Clinical history)
2.6 years to 46 years	*Generalized seizures (all types) *Focal seizures (all types) *BilateralIntermittentabnormality *Centro-Parietal spikes *Bilateral spike and wave discharges *Abnormal awake sleep inter-ictal epileptic discharge *Remote symptomatic epilepsy *Right temporal epileptic activity *single generalized paroxysms *Rolandic epilepsy *Absence seizure *Abnormalsleep waves *Presence of multifocal epileptic form activity both hemispheres with infrequent generalizations Irregular Sleeping pattern Irregular Eating pattern	*Calcification, Minimal mucosal thickening, Left temporalGliosis *Tuberous sclerosis/Pituitary dysfunction *Unmyelinated fibres, Cortical dysplasia, Compression of pituitary gland *Bilateral fronto-subcortical white matter ischemic changes, bilateral mucosal thickening maxillary sinuses, Tuberous sclerosis, Cyst *Toxic encephalopathy due to metronidazole *Hypoxic ischemic encephalopathy *Sequela of prior ischemic insult *Hypomyelination corpus collosum *Mild dysplasia corpus collosum *Thinningofcorpuscollosum/atrophyofthe body and tail of rt hippocampal formation/Periventricular leukomalacia *Type II Lissencephaly pachygyria/bilateral symmetrical colpocephaly *Polymicrogyria bilateral frontal cortices/moderate gen. cerebral and cerebellar atrophy *Porencephalic cyst/Meningitis/ *pontocerebellar hypoplasia *Intrauterine insults	Neonatal to46 years of age Mild to Severe intensity (1% mild and 99% moderate to severe)	*Radiation for mother during pregnancy *Fall from tree, ladder, Swing etc. *High fever for mother in pregnancy *Polio dose allergy for the child *High fever at neonatal stage and childhood *Trauma for mother in pregnancy/road accidents *Medicine adverse effect for mother/ pesticides exposure for mother *Vaccine adverse effect for child *Chicken pox for mother in pregnancy *Pneumonia/high fever *Asthma for mother/ breathlessness episodes in pregnancy *Hypoglycemia for mother in pregnancy *Dry delivery for mother * Hypothyroidism *Congenital heart disease *Microcytosis++, Atypical cells (Virocytes)/ Headaches

Table 1

At the time of first consultation each patient's clinical details, general history and medical history was taken in detail. Minimum 1 hour was spent with the patient and the caregiver, taking life history from pregnancy period for mother, birth time, possible events in patient's life including genetic disorders if any, falls, medicine reactions, allergies, trauma, eating habits, sleeping pattern etc. Considering medical records specially EEG and MRI reports, "BrainNext" testing sheets were used to find out the affected cognitive domains and the level of deficit for that domain. Table 2 explains about the "BrainNext" tool sets used and the systematic program observed for 152 patients and their responses to the rehab program.

The 15 days program using combination of varied "BrainNext" tools was explained to the caregiver which was different for each patient. The caregiver was told to rehearse the exercises in a specific way using tracing papers, acrylic shapes, stencils and guided on how to use the material for different exercises effectively. The exercises practice was suggested for minimum 4 to 5 hours daily initially, keeping 1 to 2 hours gap in one set of exercises and the same set was suggested to repeat for the entire day for 15 days, keeping flexibility in time and repetition of exercises according to the capacity of the individual patient. 1st Follow-up was taken after 15 days and re-assessment was done to observe the changes and accordingly, new exercises were given continuing previously suggested exercises. The caregiver was explained about the expected outcome from the rehearsal and was told to record all revisions done each day. Patients having speech and motor deficit due to varied reasons by birth or due to other injuries, infections to the brain were supported with special speech development and specific fine motor exercises in "BrainNext". Patient progress was observed for 4 to 5 months and further follow-ups were suggested according to the need by the patient and the caregiver (Table 2).

N **Total = 152**	**M**	**F**	**Age range (years)**	**Training duration (months)**	**Neurorehab-program** **Duration months no gaps** **Improvement (in %)**	**Neurorehabilitation-program** **Duration months with Intermittent Gaps** **Improvement (in %)**
					(Base condition = 0%)	(Base condition = 0%)
					(Start = 0 to 4 months)	(Start = 0 to 9 months)
					(Caregiver support)	(moderate Caregiver support)
146	66	80	2.6 - 45	Total 19	(Base condition, moderate to severe deficit N= 66)	(Base condition, moderate to severe deficit N= 80)
					(Start = 0 – 4 months)	(Start = 0 – 9 months)
					Improvement from basic condition 45% to 80%	Improvement from basic condition 25% to 55%
					Visit every 15 days = 2 months Followed by one visit each month for 3rd and 4th months *amongst 26 improved up to care giver's satisfaction, needed no further visits	Irregular visiting pattern
06	6	0	8 - 17	N/A	New patients with < 15 days duration	1st Follow-up not yet recorded

Table 2: *Patient data - Epilepsy foundation July 2018 to February 2020.*

The patients from abroad were given 6 months program and was revised when they visited for follow-up after 6 months. Some of the Arabic speaking caregivers and adult patients were supported by interpreters but the "BrainNext" tools didn't require any translations, except for the language specific alphabet sheets. Besides the language comprehension part, other "BrainNext" tools had no language barrier for application.

Among 152 patients 5 patients were supported with specially designed exercises to correct the vision loses. Each patient's responses were recorded in an audio and video format to see the positive changes.

Results and Discussion

The patients N = 72 Male and N = 80 Female population ages between 2.6 to 45 years received memory and cognitive rehabilitation treatment with "BrainNext" tools. The rehabilitation method was based on "Synaptic plasticity" that considers brain structural deficit, neurochemical disturbances, neuronal damages and electrical signal hindrances and irregular pattern of electrical and chemical signal processing, receiving and circulating due to varied reasons as listed.

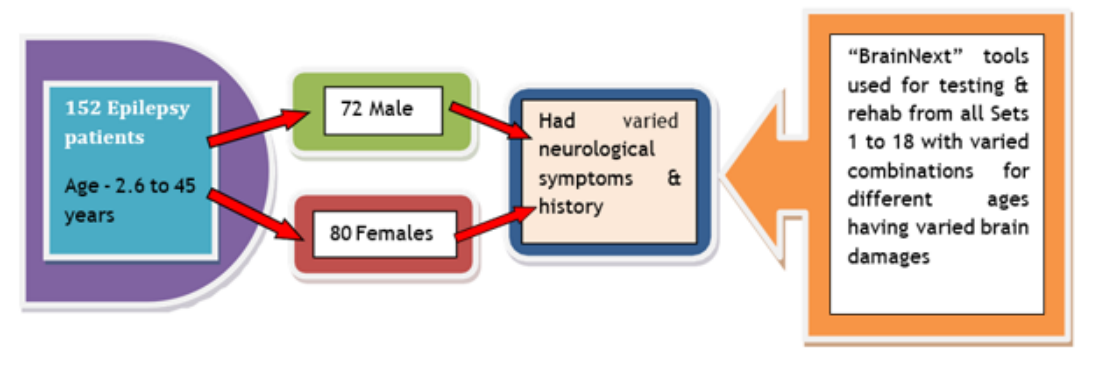

Figure : *The schematic presentation of the application of "BrainNext" rehab program.*

The "BrainNext" memory and cognitive rehabilitation program given in various material and methodological forms showed positive results in first 15 days with improvement in the attention span, following instructions, increased motor responses, behavior correction and speech clarity. The recovery phase in patients having global developmental deficit was observed with speech generation after many years, body balancing, fine and gross motor stability with improvement in pincher movement. Patients hyperactivity, pacing and disorientation improved > 15 minutes, focusing on the task and performing appropriate motor reactions.

Positive development started in Behavioural responses by the end of 15 days of treatment. Visual stability, fine motor stability improved significantly in the first 15 to 20 days.

Overall >10% improvement was seen in N=146 patients among N=152 based on the baseline condition of 0% at the start of the rehabilitation program. Among 152 patients, 6 patients were new, and the first follow-up was yet to be recorded.

The first follow-up taken after completing 15 days program the level of exercises was increased with little more details for each of the cognitive domain as given in the first 15 days program. The development in the previous cognitive domain was observed > 25% at the end

of 1month program with increased capacity in information processing, initiating actions by itself, general speed increment in acquiring information and motor actions. At the end of one and half month > 40% progress observed from the baseline condition. The information processing capacity increased and the next level of memory and cognitive exercises along with new cognitive domain exercises were added. The 4th follow-up taken after two and half months observed more positive improvement in memory and cognitive functions and behavior correction.

Next 3 follow-ups once in a month observed with increased memory and cognitive responses. Reasoning capacity increased, word creation, language comprehension and numerical functions were advanced than before. Emotional expressions like cry, anger, joy, expressing concern for the caregiver, interaction with the peer group was increased. The improvement in severe patients was observed in their facial expressions, speech muscles with normalizing chewing capacity and orientation. For the patients having speech deficit, the speech generation and clarity in speech was significantly improved by the end of 1 and half months. Their fine motor and gross motor responses increased within first 15 days and it continued to develop significantly within 2 months.

The school-going moderate to severe patients ages between 3 to 16 years could gain a lot of age specific academic learning within 5 to 6 months about language, numerical, spatial understanding with increased grasping speed, self-confidence to question the teacher or answering the questions with own translations using logical sentences. Some of them continued with their normal school where previously they were rejected and asked to leave. The children going to special schools were promoted to higher tasks and skills, adored for their good work. Seizures were in control, frequency and duration decreased for many patients with severe epilepsy, which improved over the time. The caregiver observed increased level of motivation for new learning for their loved ones. Memory was significantly improved for all patients besides their level of cognitive impairment and the clinical history and severity of seizures.

The "BrainNext" systematic program showed significant progress for patients N=66, with timely follow-ups, having no gaps in training improved > 45% to 80% from the baseline condition within 4 months though having moderate to severe seizure episodes. The patients N=80, who had irregular visiting pattern for follow-up and long gaps in training showed >25% to 55% improvement in 9 months though had moderate to severe seizure episodes. N = 6 patients were new and their first follow up results were yet to be recorded. For some patients with Tonic-clonic seizers, blackouts and unconscious episodes the brain learning was retrieved just in 1 or 2 days and the brain was ready for new learning experience again.

Conclusion

Neurons communicate using both electrical and chemical signals and plasticity takes place in various forms such as at the synapses, within neurons, within glia neuronal circuits, organizing functional representations, creating cortical maps to restructure past cognitive learning. And the cognitive learning lost due to deficit occurred while the human brain evolves with life experiences at different stages of life or it may be new learning experience for the human brain having developmental deficit; the functions of neuronal circuits exhibit similar and long term impact that deteriorates if not corrected at appropriate times.

It is a scientific phenomenon, while observing positive improvement for the human brain having developmental deficit treated with synaptic plasticity (Table 3), and similarly positive improvement for the traumatic brain or the normal brain suffering due to other diseases such as Alzheimer's, Stroke, Parkinson's or any rare diseases, reversing its deficit and re-learning by neuronal plasticity, both evidences are the human brain's miraculous response to improvement. With "BrainNext" exercises, it is observed that in the prolonged developmental deficit the neuronal activity triggers the activation of postsynaptic second messenger systems making an alteration in the level of intracellular calcium in the postsynaptic neuron. The calcium-dependent second messenger systems alter the activity of protein kinases (phosphorylate target proteins) thus gaining the basic/normal capacity of retrieving previous learning and the capacity to receive and process new information.

Neurorehabilitation training duration - 5 Feb.2019 to 5 Nov. 2019			
Testing with "BrainNext" test sheets -1st visit	3 Visits every 15 days interval (2 visits)	2 Visits every 1 month (2 visits)	1 visit every 2/3 months (3 visits)
Tested domains as follows- *Object/shape/colour recognition/Memory retrieval *Attention span/Following simple instructions/Basic strokes rendering *Speech clarity/behaviour (material + training)	>35% improvement observed - Object/shape/RED colour recognition & Memory - Attention span/initiation -Following simple instructions/fine & gross motor/Basic strokes rendering/behavior/speech clarity -next level added...	>50% improvement observed -in the previous exercises adding higher level details -behavior, logical thinking, urinary incontinence improved /Fine motor control observed in basic strokes/object/shape recog./memory/attention/ visual stability/initiation	>65% Improvement observed -better behavior, scholastic performance, improved up to caregiver's satisfaction-once in 2 months visits required after Nov. 2019, after Jan 2020 no regular visits required-HON/Vision improved >70% no surgery req./Child's self-learning capacity increased

Table 3: *Case study for step-by-step "BrainNext" program.*
"BrainNext" tools training program observed memory and cognitive domain exercises - an epilepsy patient featuring major fall/ head injury history (normal dev. seizures after trauma)
*D. S., male, 15 yrs. old, seizures since had a fall at 7 yrs. of age from 7 ft., moderate to severe cognitive deficit, attending normal municipal school treating for basic domains with "BrainNext" (memory and cognitive rehabilitation tools). Cognitive domains tested and treated for R –*numerical (basic addition of two digits) *memory (STM, WM, LTM) *spatial distribution (visuo-spatial-motor task).*

The alterations in protein phosphorylation mediate the early stages of long-term synaptic plasticity and the long-lasting changes in synaptic strength are brought about by alterations in gene transcription and based on this mechanism and principle of neuronal plasticity significantly gives positive results with "BrainNext" tools.

While providing training with "BrainNext" tools it is observed that the patients once achieve a level of cognitive enhancement, they do not lose previous learned information and continue to learn new concepts with self-motivation besides having moderate to severe seizures during the training program. Additionally, with regular visits, we witness that they do not need help after 4 and half months as the brain develops its own capacity to capture, translate, register and apply new sensory-motor information very effectively and independently.

Most of the children who didn't have developmental deficit but had seizures due to some trauma had to leave their academic education in the middle but with "BrainNext" program they regained the lost information faster besides the YLD and duration of the deficit and severity of seizures (Table 4). Some of the epilepsy patients were undergone surgery such as Temporal lobectomy, Corpus callosotomy once or twice in their life and had developed uncontrolled seizures and severe memory, motor and cognitive deficit observed to be improving with "BrainNext" program.

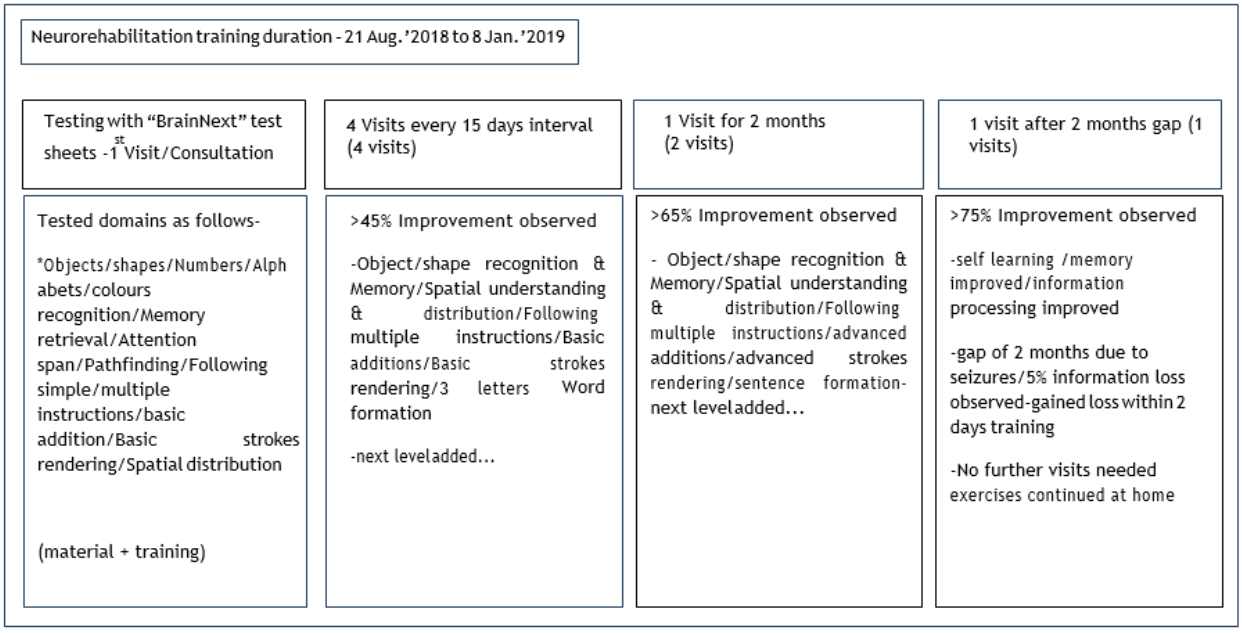

Table 4: *Case study for step-by-step "BrainNext" program.*

The revision of the previous exercises and the improvement was verified, and further exercises were given after every 15 days gap 3 times and the gap was increased to once in a month for another 2/3 months and once in 2 months as the training was required. Among N = 152 patients, for N = 6 new patients the first follow-up couldn't be recorded in March 2020 as the nationwide lockdown started due to Covid-19 in India.

At the end of one and half month with 3 follow-ups of 15 days interval, > 40% progress from the baseline condition was observed. The new information processing capacity increased and the next level of memory and cognitive exercises were added. The number of exercises increased, and new cognitive domains were added at the time of follow-ups. The patient's responses increased with speed and understanding at each level. Many sensory-motor functions such as sensing "dangers", asking logical questions, emotional expressions etc., which were not directly trained those observed to be learned by the brain naturally as the brain achieved its capacity for effective environmental interaction as the rehab program advanced.

Some of the patients below 12 years of age in children category had experienced only single seizure episode in their early life but had developed significant cognitive deficit and as they started attending school, they seemed to be lacking in grasping academic learning, they couldn't keep the fast pace of learning in the normal school and soon were down-graded to slow learner's category. "BrainNext" tools program helped these children to cope with the speed by filling the "information gap" within months. Children previously detected with learning disability, ADHD, Autism, mild retardation made significant recovery and showed improved IQ levels. The children population having severe to moderate disability showed significant recovery within few months with better cognitive and motor responses than before.

The school-going moderate to severe patients ages between 3 to 16 years could gain a lot of age specific academic learning within 5 to 6 months and could be able to re-learn language, numerical, spatial understanding with increased grasping speed and elevated self-confidence to question the teacher or answering the questions with own translations using logical sentences. Some of them continued with their normal school where previously they were asked to leave.

The children going to special schools were promoted to higher tasks and skills, gained appreciation for their good work. Seizures were in control for many children, frequency and duration decreased for many with severe epilepsy. The caregiver was much positive and motivated to be trained to provide new learning for their loved ones. Memory was significantly improved for all patients besides their level of cognitive impairment, clinical history and severity of seizures. Many patients detected with developmental disorders could regenerate speech and achieved clarity in speech and facial expressions, those were observed for the first time since they were born.

The most important factor about the "BrainNext" tools is, it manages nano-learning very effectively and does not segregate stored memory due to seizure episodes. The "BrainNext" program observed faster and effective recovery of lost sensory information in epilepsy patients though the patient experienced moderate to severe seizure episodes during and after training (Table 5). For some patients with Tonic-clonic seizers, blackouts and unconscious episodes the information loss was retrieved just in 1 or 2 days and the brain was ready for fresh learning experience-once again.

"BrainNext" Sets used for the 152 Epilepsy Patient population		
Set No. used Beginning steps	**Set description**	**Cognitive domains covered**
1	SET1 – Understanding numbers and learning counting- activities + 3D Number shapes (Laminated sheets, 3D Numbers, Acrylic shapes)	Learning basic counting, counting different objects in pictures, learning graphical form counting, understanding similar group of objects and counting of groups, 2D to 3D number concepts, writing/recognizing with colours, shapes, advanced numerical skills and many more…
2	SET2 – Understanding English Alphabets - activities + 3D Alphabet shapes (Laminated sheets, 3D Alphabets - Capital & Small, Acrylic shapes)	Understanding alphabets capital and small letters Aa to Zz, Understanding alphabetical sequences in capital and small alphabet groups. Identifying missing alphabets in 2D to 3D alphabet concepts, forming words/language comprehension basics to advanced…
7	SET 7 – Strokes and Stencils - Activities+ 3D Stencils (Acrylic boards with special designs/shapes, Laminated sheets with basic to advanced strokes)	Rendering strokes on the tracing paper provided using the strokes drawing references, Rendering strokes by observing and then drawing on different paper *Using stencils to understand and practice complex strokes *Refining and controlling finger and hand movements
13	SET13 – Identify objects and Memorize – Activities + 3D alphabets (Laminated sheets for specially designed memory retrieval step-by-step guidance)	*Identifying objects, making rehearsal and memorizing and covering all aspects of memory *Writing first letter of each memorized object on different paper *Creating spellings of rehearsed objects *Decreasing rehearsal and increasing memory retrieval as per given instructions
12	SET12 – Understanding emotions, improving Speech - activities + mirror + 3D Alphabet shapes (Laminated sheets for speech based on vowels, facial expressions, support material)	*Pairing appropriate emotions as shown in the pictures *Understanding negative and positive emotions *Finding first letter for every emotion and creating spellings *Speech exercises with specific vowel expressions to improve speech clarity
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Table 5: *"BrainNext" sets used for the 152 epilepsy patient population.*

******Other cognitive domain sets added as the brain progressed, based on individual patient's baseline condition.*

With healthy synaptic transmission and effective learning process the positive change is observed to be profound across all patients and the change seemed to be ultimately reflected in the organization of functional representations in the brain. Synaptic Plasticity can affect the structure and function of entire neurocircuits, which are comprised of multiple neurocircuits operating in series and in parallel system, contributing to the entire wellness of CNS dependent systems. Plasticity is a means by which we can constantly update and refresh the learning besides the developmental deficit, injury, ischemic conditions, rare brain infections etc. The representation that is stored, even across an entire cortical area observed to be retrieved by using "BrainNext" tools for the Epilepsy patients at Epilepsy Foundation India.

Conflict of Interest

None.

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