A Handbook on Neurological Disorders for Special Educatërs



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This book is basically a compilation of information / literature on the available on the topic, from various sources (which have been acknowledged duly). However, this is by no means an exhaustive resource, since the field is evolving at a very rapid pace. Every effort is made to ensure accuracy of material, but the publisher, printer and author will not be held responsible for any inadvertent error(s).

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Preface

With the increase in children afflicted with neurodevelopmental disorders such as autism, cerebral palsy, intellectual disability and other conditions such as learning disability, the role of special educators in a child's academic life is becoming more and more vital. Infact, this role often extends and spills over into child's overall development, which includes his/her activities of daily living as well as social and emotional wellbeing. At NeuroGen, as we work with children with various neurological disorders, we have realized the importance of special educators in the rehabilitation team.

Special educators, infact, are the bond which links the child to his parents. Well informed special educators can become the providers of a holistic care and therapy for a child. They can guide the parents in the right direction and be the beacon of hope for the child with special needs.

Keeping this in mind, the team of Neurogen Brain and Spine Institute has put together a very simplified and easy "Handbook on Neurological Disorders for Special Educators".

This book outlines the various neurological disorders that the special educators are likely to encounter, so that they can understand the basis of the condition in order to provide proper guidance to the child / individual.

It is every child's right to be educated, whether the child is neurotypical or has some disability. We believe that empowered and knowledgeable special educators will lead the way in helping the children reach their full potential.

Just as Hellen Keller's teacher, Anne Sullivan, helped her become an inspiration for millions around the world. We are sure, this endeavor from our side, will help you, in a small way to guide such children with neurological disorders towards an independent life.

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CONTENTS

1.	Introduction	9-12
Sect	tion A: Disorders	
2.	Autism Spectrum Disorder	
3.	ADHD	
4.	Intellectual Disability	
5.	Down's Syndrome	
6.	Learning Disability	
7.	Global Developmental delay	
8.	Cerebral Palsy	
9.	Neuromuscular Disorders	
10.	Others Neurological Disorders	61-68

Section B: Multidisciplinary Treatment

11.	Medical Management	
12.	Special Education	74-76
13.	Psychological Intervention	
14.	Applied Behaviour Analysis (ABA)	
15.	Physiotherapy	
16.	Occupational Therapy	
17.	Speech Therapy	
18.	Art Based Therapy	
19.	Hand Therapy	
20.	Aquatic Therapy	
21	Animal Assisted Therapy	

Section C: Recent Advances

22.	New Rehabilitative and Regenerative Technological Advances	115-118
23.	Stem Cell Therapy	119-137

Chapter 1

Introduction

"Things don't change. You change your way of looking at them"

Neurological disorders are diseases that mainly affect the brain, spinal cord and the nerves of the body. There are more than 600 neurological disorders identified which occur at different stages of life. Many of them are congenital and some are acquired after birth due to known or unknown causes. They produce a wide range of debilitating symptoms such as paralysis, weakness, loss of coordination, cognitive impairment, behavioral issues, learning difficulties and even seizures. This may result in lifelong disabilities and limit / restrict day to day functioning of the affected individuals making them dependent for all their basic needs on their family members or caretakers. Hence, directly impacting their quality of life along with that of their caretakers. These neurodevelopment defects affect the learning capacity of the children and hampers their schooling because of the decreased cognition. As a result, they stay unemployed and have to lead a dependent life.

Due to various factors, such as environmental and genetic, the occurrence of neurological disorders worldwide is increasing drastically. This increases the socio-economic burden on the society. World Health Organization(WHO) and the World Federation of Neurology (WFN) recently collaborated in an International Survey of Country Resources for Neurological Disorders involving 109 countries and covering over 90% of the world's population. The findings show that resources are clearly inadequate for these patients in most parts of the world. Hence, it is important to identify, manage the symptoms and arrest the worsening of the disorder. Early detection and timely intervention would redirect the neurodevelopmental defects of the children towards normalization and integrate them into mainstream schooling.

In this book, we have mainly focused on the neurological disorders seen in pediatric population such as Autism, cerebral palsy, ADHD, Intellectual disability, Down's syndrome, Learning Disability, Global developmental delay, Neuromuscular disorders, etc. In children, the occurrence of these disorders is either at birth due to congenital causes or after birth due to pre/perinatal causes or acquired causes. Children start presenting symptoms at early developmental stages. Parents notice abnormalities when developmental milestones are not achieved on time or they behave differently in schools. All these disorders are incurable, however rehabilitation, pharmacological and surgical interventions have been used individually or in combination to manage the symptoms.

The main aim is to repair the underlying neurological damage. With the breakthrough stem cell science, this is now possible. A child's brain is plastic and moldable. So, if it is repaired at the developmental stage, we can regain maximal function. Once the repair is done, these areas need to be trained by various rehabilitation and learning methods. Hence children with neurological problems require special attention and unique strategies for education.

Schooling is extremely important for the development of these children. Due to various physical or mental challenges, they cannot be a part of normal schooling which at times discourages the parents and children and deprives them from education. Special schools with special educators play a vital role in their education and development.

This book is specially compiled for the special educators to empower them with latest advances in treatment of neurological disorders. It specially focuses on various new therapeutic options for neurodevelopmental disorders in children. It gives basic information of these disorders along with standard treatments available for them. It describes the role of each treatment strategy in detail. This book can serve as a guide to special educators while planning holistic multidisciplinary treatment program for special children. It can be a powerful tool while offering guidance to the parents of these special children.

In our view, it is extremely important for special educators to know about these disorders as every affected child is different and may require personalized intervention. They can create awareness amongst parents about various new and conventional treatments available for their children. Special educators can help to improve the condition of the child by working in sync with the therapists from different areas. If all the therapies are given in timely manner and in harmony, it can enhance the development and improve the quality of life in these children.



Occupational Therapy



Physiotherapy



Speech Therapy



Aquatic Therapy



Dance Therapy



Art Therapy



Sensory Integration Therapy



ABA Therapy



Stem Cell Therapy

Section A: Disorders

Chapter 2

Autism Spectrum Disorder

"Autism is an abnormal brain functioning disorder"

What is AutismSpectrum Disorder?

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder which typically appears during early childhood. The term Autism was first used by Leo Kanner in 1943. He described it as a psychological disorder. According to his description, people with Autism show "an inability to relate to in an ordinary way to people and situations". According to the DSM V criteria, ASD is a spectrum of disorders which includes Autism/Autistic Disorder, Asperger's Syndrome and Pervasive Developmental Disorder – Not Otherwise Specified (PDD-NOS). As per the Centers for Disease Control and Prevention (CDC), the prevalence rate of ASD is 1 in 68 children.

Symptoms of ASD

- Autism Spectrum Disorder involves a large range of symptoms, and level of impairments such as:
- Impaired social interaction which makes it difficult for them to initiate a conversation with other people.
- Impaired cognition and problem solving skills.

- Not responding to name
- Difficulty in understanding other's expressions and emotions.
- Difficulty in conveying their needs appropriately
- Repetitive and restricted patterns of behavior and interest
- Failure to make and maintain appropriate eye contact with others
- Sensory issues like
 - Avoids touch or seeks more physical touch, avoids/seeks certain texture of clothing or food
 - Seeking constant movements of different parts of the body like rocking, swinging, hand flapping, jumping or avoiding movement like fear of climbing stairs, avoids swings, and traveling.
 - Hypersensitive towards loud noise
 - > Licks and tastes certain textures or avoids certain textures or food items
 - Staring at spinning objects, light objects
- Hyperactivity in the form of excessive restlessness, physical activity and not sitting at one place.
- Difficulty in Non-verbal communication and understanding non-verbal ques of others
- Self-injurious behavior like self-biting, head banging
- Difficulty in Adapting to change
- Delayed speech and language skills
- Inappropriate emotional responses like laughing and crying without reason
- Inappropriate attachment towards objects
- Difficulty in carrying out activities of daily living

Possible Causes of ASD

- Prenatal Factor like advanced age of the mother during pregnancy
- Health of the mother during pregnancy like diabetes, hypertension, stress, thyroid, use of psychiatric drugs during pregnancy.

- Neo-natal factors such as low birth weight, lack of oxygen of the child during birth, seizures, infections etc.
- Postnatal factors like allergies, high fever, immune system abnormalities, exposure of children to drugs, certain food, or heavy metals.
- However, there is no substantial evidence and one single cause that supports where it has come from.

Diagnosis of ASD

There are certain early signs of ASD which are noticed by the parents, teachers and caregivers. Many a times, they fail to notice early signs of ASD. Reason behind this is lack of knowledge among parents and teachers, this lead to delay in the child's intervention. Diagnosing ASD in children requires assessment by multiple evaluators, using different assessment tools and methods. This is done by Psychologists, Developmental pediatricians, an Occupational therapist, and speech and language therapists. This team carries detail observation, assessment, tests and pinpointing each and every chief complaint of the patient. This includes:

- Parent's interview by a Psychologist in which parents are asked about the developmental milestones, their habits, abilities, and challenges the child is facing.
- Psychologists take a detailed history of the patient in the form of assessing and observing his/her attention and concentration abilities, understanding level, social interaction and if there is any family history of similar condition.
- Various psychological tests which are designed to evaluate the child are carried out and the diagnosis of the child is confirmed.
- Occupational therapists assess the patient's chief complaints such as fine and gross motor skills, sensory issues, eating, bathing, dressing and toileting.
- They also assess muscle tone, posture and strength of the patient.
- Speech and language therapists observe the patient's receptive and expressive skills, voice quality including use of intonations.
- Pediatricians also recommend auditory tests i.e. BERA, to identify if there is any hearing problem.

MRI

Magnetic resonance imaging (MRI), can detect only structural changes in the brain. SinceASD is associated with functional abnormalities, most of the patients show normal brain structure with no significant damage. MRI is normal.



MRI showing normal brain structure in ASD

PET CT scan

18F-fluorodeoxyglucose(FDG)-Positron emission tomography (PET) is a functional neuroimagingtechniques which uses radiolabelled tracer. FDG uptake by brain cells is measured which is proportional to metabolism. The function of brain directly correlates withbrain metabolism. In most of the ASD patients, PET scan shows abnormality in the medial temporal cortex, cerebellum,frontal cortex, basal ganglia and thalamus. The blue region reflects hypometabolism(which means decreased metabolism or low functioning regions or underconnectivity), red reflects hypermetabolism (which means increased metabolism or high functioning regions or over connectivity), green reflects normal brain glucose metabolism.



FDG-PET image of a ASD patient showing damaged/abnormal areas of the brain

Treatments Available for ASD

Treatment of ASD requires involvement of patient's family as well as team of professionals. Recent interventions for Autism Spectrum Disorder includes ABA therapy which involves one-to-one sessions, group sessions, social training sessions as well as parent training. Speech therapy, Occupational Therapy and Special Education. Apart from this, therapies like stem cell therapy, chelation therapy, HBOT, Auditory Integration therapy, animal assisted therapy are also provided for the treatment of ASD. Apart from therapies medicines are commonly used as a treatment for the symptoms of hyperactivity, problem behavior, anxiety and sleep problems

Psychological intervention

Early symptoms of ASDarerecognized when parents notice that the child is not giving appropriate eye contact, s / he is not responding to his / her name, social interaction and communication is not age appropriate. Psychologists play an active role in diagnosing a child showing symptoms of ASD. Psychological intervention begins with a detailed psychological assessment along with conducting tests to assess the severity of the child. Some



of these tests includes Childhood Autism Rating scale (CARS), Gillium Autism Rating scale (GARS), Indian Scale for Assessment of Autism (ISAA). Once the detailed assessment and tests are done, on the basis of an individual's severity, an appropriate treatment is planned. Psychologists work actively with the kids and parents by setting goals for them and also giving goals to parents to implement at home. Family counseling is also conducted to help the families cope up with emotional distress associated with their child's illness. Parents are also trained regarding how to handle the kid, what teaching strategies to be implemented at home. Psychologists work along with ABA, Occupational, Speech and Remedial therapists for the correct intervention of the child. Parent rating scales and caregiver burden scales are also conducted on the caregiver/parents to assess the level of stress and burden on them. This helps the practitioner to get an insight about difficulties and emotional issues faced by them.

Occupational Therapy

Goals of occupational therapy are:

- 1. Maintaining the arousal level of the child.
- 2. To improve eye contact.
- 3. Improve attention and concentration.
- 4. Improve social skills.
- 5. Improve gross and fine motor skills.



- 6. Improve eye hand co-ordination.
- 7. Improving motor planning.
- 8. Improving functional independence by using adaptive devices and assistive technology.
- 9. Home, Environmental and classroom modifications.

Treatment strategy includes sensory integration therapy which helps the child get exposed to different sensory stimuli in a structured and repetitive way.

Sensory Integration



Sensory integration mainly refers to the integration and interpretation of sensory stimulation from the environment by the brain. Hence, when there is a dysfunction in sensory integration the sensory input is not integrated appropriately in the brain which produces varying degrees of problems in development, infor-

mation processing, and behavior. Children with ASDhave dysfunctional sensory system wherein their senses are either over- or under-reactive to stimulation. These sensory issues may be the cause of their typical rocking, spinning, and hand-flapping behavior.

To address these issues, sensory integration techniques to are performed by therapists which facilitates attention and awareness and reduces over all arousal.

Speech language therapy

Each child with ASD is different from the other and so are their speech & language skills.

Based on their speech & language skills children with ASD can be divided into 3 categories:

- ☑ Completely nonverbal
- ☑ Minimally verbal
- ☑ Children with Higher language skills deficit.



In children who are completely non-verbal and have no speech can be taught to communicate using various non-verbal modes of communication i.e. sign language, letter board communication, low tech or high tech AAC boards or devices, etc. Whereas, children who are minimally verbal can be given early intervention to encourage and teach themverbal communication skills. Now the focus for children with ASDhas been communication training rather than only speech training.

Special Education



A special educator plays an important role in enabling the child with ASD to reach his/her full learning potential. Children with autism have issues with behaviour, socialization and communication. A special educator can help these children adapt and learn. Since every autistic child learns differently, an Individualized Education Plan (IEP), tailored for an individual, with the aim of providing the maximum educational results, is of vital importance. This requires a collaboration of

parents and schools. An IEP must address all the areas of needs of the student.

Some of the special education techniques used in individuals with autism:

- Lovaas model: A skill is broken down into small steps which are practiced in a variety of settings. Positive reinforcement in the form of verbal praise or something that motivates the child is given on achievement of the desired results.
- **Floortime model:** Involves play activities intended to focus on developing child's interest in the world, communication and emotional involvement.
- **Picture Exchange Communication System (PECS):** Used for children with little or no verbal ability. It makes use of pictures to build the child's vocabulary.
- **Pivotal Response Treatment (PRT):** It is a child directed intervention, aimed at producing positive pivotal behaviours.
- Training and Education of Autistic and Related Communication Handicapped Children (TEACCH): It involves capitalizing on the relative strength and preference for processing information visually, to create a highly-structured environment that helps the individual map out activities and work independently.

• Social Communication/ Emotional Regulation/ Transactional Support (SCERTS): It involves the use of other approaches to promote child-initiated communication in day to day activities and as much as is possible in inclusive setting.

Physiotherapy



Research has shown that motor (movement) skills are impaired in individuals with ASD. Motor coordination, postural control, and learning of skills through imitation of the movements of other persons may be limited, and planning and completing new motor tasks are challenges for many children with ASD. Early motor delays in children with ASD may contribute to difficulty acquiring social skills. Early intervention services by physiotherapist

can help children with ASD learn important skills and improve development. Early diagnosis can help a child with ASD achieve full potential.

Stem cell therapy

Stem cell therapy is a new effective treatment strategy which has shown great results in ASD. All the above therapies manage the symptoms of ASD. However, Stem cell therapy addresses the core underlying pathology of ASD. It helps in restoring neural connectivity, immune balance, oxygenation and reducing inflammation. This repairs the abnormal brain function and thereby resolves the sign and symptoms of ASD. Research has shown that stem cell therapy can reduce hyperactivity, improve eye contact & attention, reduce repetitive behavior, improve speech & communication etc. These clinical improvements correlated with objective evidence of improved brain metabolism on PET CT Scan. Hence, Stem Cell Therapy can enhance the results of standard medical and rehabilitative therapies thereby helping these children to integrate into mainstream schooling and society. Chapter 3

Attention Deficit Hyperactive Disorder (ADHD)

"ADHD brain has a lightning speed but faulty brakes"

Attention deficit Hyperactive Disorder is a Neurodevelopmental Disorder which affects children, teens as well as adults. American Psychiatric Association(APA) in the Diagnostic and Statistical Manual of Mental Disorder (DSM-V), states that overall 5% of children have been estimated to have ADHD. This disorder includes difficulty in sustaining attention, hyperactivity and impulsive behavior. These difficulties faced by patients with ADHD affect their quality of life at home, school, and other social situations. If left unnoticed, ADHD can cause significant problems like failure in school, poor self-esteem, difficulty in carrying out normal life functions, relationship with family and friends. Many children diagnosed with ADHD continue to experience problems in adulthood as well.

Symptoms of Attention Deficit Hyperactive Disorder

- Difficulty in giving close attention and often getting distracted easily
- Making careless mistakes in schoolwork, at work, and with other activities

- Unable to listen or carry out instructions when spoken directly
- Difficulty in organizing daily tasks and activities
- Difficulty in sitting at one place for a long time
- Excessive physical movements in the form of being restless, hyperactive and fidgeting with hand or feet
- Presence of excessive talking
- Behavior of Interrupting between conversation
- Difficulty in turn taking

MRI

As, ADHD is associated with the functioning of the brain, most of the patients show normal brain structure



MRI showing normal brain structure in ADHD

PET CT scan

The regions which are commonly associated with ADHD are frontal cortex involving prefrontal cortex, medial temporal cortex, basal ganglia and cerebellum. The blue region reflects hypometabolism (which means decrease metabolism or low functioning regions or underconnectivity), red reflects hypermetabolism (which means increase metabolism or high functioning regions or overconnectivity), green reflects normal brain glucose metabolism.



FDG-PET image of a ADHDpatient showing damaged/abnormal areas of the brain

Treatments available for individuals with ADHD.

There are numerous treatments available and found to be effective for the treatment of ADHD such as Applied Behavior Analysis (ABA), individual counseling especially for adolescent ADHD patients, play therapy, Sensory Integration therapy, physiotherapy, stem cell therapy, etc. Academic performance of people with ADHD can be enhanced by remedial education by special educators/ remedial teachers. Apart from this, combination of pharmacological and behavioral interventions are found to be effective in treatment of ADHD.

Speech-language therapy



To work effectively with children with ADHD in speech and language treatment settings, professionals need to understand the principles of behavioral management. These children require, above all, consistency of program structure and routine to help them organize themselves in time, space, and, perhaps most importantly, in function. They need schedules and accompanying aids for

organizing themselves and their tasks throughout the day. To improve their attention, the most important is to cut down distractions, both sights and sounds as these children cannot ignore unimportant sounds and sights.

Psychology

When a child is diagnosed with ADHD parents are often anxious about the best possible way to deal and help their child. Psychologists work closely with the parents so that they can guide their child towards success. Once the child is assessed, a Behavior modification program is carried out. The goal of behavior therapy is to



increase the desirable behavior, strengthen more positive behaviors and reduce problematic behaviors. During one-to-one individual sessions with children, psychologists work on teaching them new skills to replace inappropriate behaviors. They also help the child to express their feelings in an appropriate manner that does not create problems for the child or other people. Parent training in behavior therapy is very effective. It gives parents the skills and strategies to help their child.



Occupational Therapy

Role of occupational therapists is to evaluate the child and to find out the factors affecting child's performance in school and at home. They play a vital role in identifying sensory processing issues and finding strategies to help the child to adapt to the environment to complete the activities independently. Techniques such as sensory integration, brain gym, alert program, etc are used to manage the common symptoms of ADHD.

Certain tips to improve attention and concentration:

- If you are a therapist or Teacher, wear a conservative clothing, clothes with soft colors.
- Talk to the child in a soft voice
- Reduce the cluttering in the room, keep the workplace of the child clean.
- Avoid keeping too many things on the workstation or the desk.
- Play soft music which will have a calming effect on the child.
- Give short tasks instead of giving a long task to the child
- Give visual and auditory inputs while completing the tasks.
- Making the schedules for certain tasks and training the child to follow the schedule.
- Giving frequent breaks, sharpening the time management skills.
- Giving the child extra time to complete the task.

Special Education

Inattention, hyperactivity, and impulsivity are the core symptoms of Attention Deficit Hyperactivity Disorder (ADHD). A child's academic success depends on his or her ability to perform tasks with minimal distraction.



Teaching a child with ADHD requires lot of patience, creativity, and consistency. Special Education for ADHD children mainly focuses on developing strategies for these children to concentrate, stay on task, and learn to their full capabilities. Children should be motivated to learn by offering rewards on a point or token system.

- Teachers who are successful in educating children with ADHD use a threepronged strategy as no two children with this disorder is same
- .Evaluate the child's individual needs and strengths.
- Select appropriate instructional practices.
- Integrate appropriate practices within an Individualized educational program (IEP).

To implement this strategy, three components should be integrated

1. Academic Instruction:

- Teachers can help prepare their students by applying the principles of effective teaching when they introduce, conduct, and conclude each lesson.
- One instruction should be given at a time and repeat if necessary.
- If possible, work on the most difficult material early in the day.
- The teachers can use assistive devises and visuals: charts, pictures etc.
- Create worksheets and tests with fewer items, give frequent short quizzes rather than long tests, and reduce the number of timed tests.
- Test students with ADHD in the way they do best, such as orally or filling in blanks.
- Divide long-term projects into segments and assign a completion goal for each segment.
- Accept late work and give partial credit for partial work.

2. Behavioral Interventions:

- Head off behavior that takes time from other students,
- Give a couple of warning signals with the student who has ADHD. This can be a hand signal, an unobtrusive shoulder squeeze, or a sticky note on the student's desk.
- Discuss the student's behavior in private.
- Ignore mildly inappropriate behavior if it's unintentional and isn't distracting other students or disrupting the lesson.

3. Classroom Accommodations:

A teacher can make changes in the classroom to help minimize the distractions

- Seat the student away from windows and doors.
- Put the student right in front of the teacher's desk unless that would be a distraction for the student.
- Seats in rows, with focus on the teacher, usually work better than having students seated around tables or facing one another in other arrangements.
- Create a quiet area free of distractions for test-taking and quiet study.

By incorporating techniques from these three areas into their everyday instructional and classroom management practices, teachers will be empowered to improve both the academic performance and the behavior of their students with ADHD. In doing so, teachers will create an enhanced learning environment for all students.

Physiotherapy



Physiotherapy may help children with ADHD improve lack of focus, poor social skills and impulsive behavior. It helps them stay calm and concentrate better. Exercise increases blood flow to the brain and helps in improving functions.

Stem Cell Therapy

Compared to the above therapies, stem cell therapy is a new treatment strategy for ADHD. Studies have shown that in ADHD, the neuronal circuitry is disrupted and also there is axonal demyelination which is loss of myelin sheath which affects the signaling in ADHD. Stem cell therapy helps in

remyelination of axons and repair of synapses which improves neuronal signaling and neuronal connectivity. This ultimately leads to better information processing in the brain and clarity of thoughts. Stem Cell Therapy in combination with rehabilitative therapies reduces hyperactivity and improves attention in children with ADHD which reflects in academic performance.

Chapter 4

Intellectual Disability

"Defects in normal processing of information in the brain"

Intellectual disability (ID) is a neuro-developmental disorder with multiple etiologies, characterized by deficits in intellectual and adaptive functioning. The adaptive deficits are due to intellectual impairment and affect social, conceptual or practical functioning, or a combination of these, in one or more settings (eg, school, home). 2–3% of the worldwide population is affected with ID. On IQ testing, children with ID score below 70 indicatinglimited intellectual functioning. Severity of ID ranges from mild to profound depending on the IQ of the children.

Type of ID	IQ score
Mild	50-70
Moderate	35-49
Severe	20-34
Profound	Below 20

Basic Characteristics of Intellectual Disability:

- Delayed developmental milestones
- Cognition is impaired
- Attention and concentration is affected.
- Delayed speech development
- Learning and understanding concepts is affected
- Difficulty communicating or socializing with others
- Lower than average scores on IQ tests
- Memory is affected
- Inability to connect actions with consequences
- Difficulty with problem-solving or logical thinking
- Inability to do day to day tasks like getting dressed or using the restroom without assistance

The region which show, abnormalities in the ID are frontal cortex and medial temporal cortex



Frontal cortex

FDG-PET image of a ID patient showing damage in frontal cortex and medial temporal cortex

ID, being a non-progressive disorder, the prognosis depends upon the extent of sensory, physical, motor and cognitive impairment of the child. Early intervention may significantly help in management of symptoms. The mainstay of management is to maintain and reduce the impairment and enhance the functional status. Multidisciplinary rehabilitation including special education, psychological intervention, physiotherapy, occupational therapy can help in alleviating the symptoms. Newer therapies like stem cell therapy have also shown promising results by addressing the neuropathology of ID at a cellular level.

Special education



Special Education plays an important role as a part of the rehabilitation program for ID. Educating individuals with intellectual disabilities requires awareness and patience.Teachers working with individuals with intellectual disabilities must know how to meet their students' unique needs. Ultimate aim of special education is to make the child independent.

Guidelines for teaching children with ID

- Make use of examples to explain new concepts.
- Provide practice in the areas they are skilled in.
- Make use of role plays and role models to develop desired behaviours.
- Make clear instructions on the acceptable behaviour in the classroom.
- Avoid complex instructions and break up instructions into simple ones.
- Use hand gestures, facial expressions and body movements for young students that have just begun to speak or are pre-verbal.
- Teaching students to remember given set of items through chunking, e.g. chunking numbers together rather than remembering them separately, use of visual feedback, etc.
- Use of role modeling and shaping techniques to reinforce desired behaviour.
- Acquire information about the child from parents, peers, etc. and learn about his characteristics and hobbies.
- Acquire input from the student to know how they learn best, thus giving them control and making them responsible for their own learning.
- Involve families and other important people in their lives, in learning activities and special days.

Teaching strategies and learning material:

Special education is all about using various tricks and techniques to teach a child different skills. Teaching strategies must be aimed at achieving the following goals

- 1. Acquisition of skill
- 2. Fluency of skill
- 3. Maintenance of skill
- 4. Generalization of skill
- 5. Concrete to abstract

Psychological Intervention

Psychological Interventions are commonly used in management and treatment of behavioral, communication and cognitive problems among individuals with Intellectual Disability. First step in psychological intervention involves a detailed assessment by a Clinical / Counselling / Rehabilitation Psychologist wherein parents are asked questions regarding chief complaints and problem behaviour of the client. Observation of the person is also conducted where the practitioner observes each and every detail regarding the person's language skills, cognition, problem solving abilities, and problem behaviours. An IQ test is also conducted and according to the score interpretation appropriate intervention is planned. This involves working on the social skills of the person using role play and modelling techniques, on cognition using visual aids and one-to-one educations programs. Psychologists also provide vocational training to these children and refer them for job placements as well. Psychological Intervention also involves parents' training and counselling sessions where parents are trained how to handle problem behaviours of the person at home, and how to provide appropriate training in day to day life.

Speech-language therapy



Children with an intellectual disability exhibit delays in language development. They can acquire both receptive as well as expressive language at an older age through appropriate intervention strategies.Each individual has a unique profile, based on his or her level of language functioning as well as functioning in related areas including hearing, cognitive level, speech production skills, and emotional status. Depending on these

factors the intervention will be designed on an individual basis to address early communication skills, social interaction and play, verbal and non-verbal communication, speech production; compensatory communication techniques and strategies, feeding and swallowing, etc

Physiotherapy

Intellectual capacity is highly influenced by the ability to receive and correctly interpret the incoming sensory input received from the five senses: sight, sound, touch, taste, smell. Various senses work together in unison which help people move within their surroundings. However, few children with intellectual disabilities have difficulty interpreting, integrating, and coordinating sensory information. Sensory integration activities help these children strengthen these



abilities. The underlying condition that caused the intellectual disability determines whether physiotherapy is recommended. Many children with cerebral palsy, GDD, metabolic disorders, DMD etc may have secondary ID.. For example, few children may have poor muscle tone contractures, poor recruitment of muscles, poor co-activation of postural muscles, impaired balance, etc which can be corrected with the help of regular physical therapy.

Occupational therapy



Stem cell Therapy

Occupational therapy mainly helps the participation of children with ID in the society and help in community integration. Occupational Therapy for ID mainly aims atimproving cognitive skills, Engaging the child in meaningful and purposeful activities, Training the child to perform instrumental ADLs and leisure activities, Preparing and training the child for employment and improving the academic performance.

Stem cell therapy along with standard treatment can improve not only IQ but also adaptive functioning. With the unique property of differentiation into neurons and other specialized cells, stem cells can repair the brain abnormalities. Stem cells release positive chemicals and growth factors which cause the suboptimal functioning neurons to work better. It also improves synaptic connectivity which enhances transmission of proper signals inbetween neurons. This helps to repair the defects in information processing which results in better understanding. Stem Cell Therapy improves cognition, awareness, behaviour and overall independent functioning of the children with ID. Chapter 5

Down Syndrome

"Abnormal chromosomes causing abnormal physical & brain development"

Down's syndrome also commonly known as "Trisomy 21" is a set of physical and mental impairments which is caused by a genetic problem and occurs before birth.

Causes of Down syndrome

Down syndrome occurs when an individual has a full or partial extra copy of chromosome 21. This additional copy of chromosome affects the physical and mental development of the child and causes the symptoms associated with Down syndrome.

Symptoms:

Most children with Down syndrome have:

- Distinctive facial features, such as a small head, flat face, unusually shaped or small ears, slanting eyes, small mouth and protruding tongue.
- Broad and short hands.
- Excessive flexibility
- A short neck and short arms and legs.
- Low muscle tone and loose joints. Muscle tone usually improves by late childhood.
- Below-average intelligence.

Most children with Down syndrome are also born with heart, ear, intestine, or respiratory problems. These health issues often lead to other problems, such as recurrent airway (respiratory) infections or recurrent ear infections causing mild to moderate degree of hearing loss.

Infants with Down syndrome may be of average size, but typically they grow slowly and remain shorter than other children of the same age.

MRI

MRI of DS exhibit several types of structural brain abnormalities. Down's syndrome show reduced overall brain volumes, with disproportionately smaller cerebellar volumes and relatively larger subcortical gray matter volumes. MRI shows thickened corpus callosum with increased grey matter volume.



Reduced brain volume

FDG-PET

The region of the brain which show abnormality includes frontal cortex, medial temporal cortex and cerebellum.



FDG-PET image of a DSshowing damage in the frontal cortex, medial temporal cortex and cerebellum

There is no single, standard treatment for Down syndrome. Treatments are based on each individual's physical and intellectual needs as well as their personal strengths and limitations. Physiotherapy, occupational therapy, speech-language therapy, behavioural therapy, special education, drugs and supplements, use of assistive devices are few treatments used to manage children with Down syndrome.

Speech and language therapy:

The aim of speech therapy for children with Down syndrome is to establish effective communication skills and use language more effectively. It can help them develop early skills necessary for communication, such as imitating sounds and also develop conversation skills, pronunciation skills, comprehension, learning and remembering words. Speech therapists can also help the child use alternate means of communication such as sign language and pictures to communicate their needs.

Psychological Intervention:



Children with Down Syndrome have cognitive deficits. Psychological Intervention involves a detailed assessment of the individual. Cognitive rehabilitation therapy is conducted which attempts to enhance the functioning and independence of children with Down syndrome. Psychologists conduct group therapy sessions which teaches them appropriate socialization skills. It also provides a support system for these

children. Group training sessions can be conducted for the parents also as this would provide them with an interactive forum where they could seek advice from professionals and other parents.

Physiotherapy

The main goal of physiotherapy for children with Down syndrome is to minimize the development of compensatory movement patterns. It is observed that these children compensate with hypotonia, joint laxity, reduced muscle strength and short



limbswhich if not addressed at the right time and allowed to persist leads to orthopaedic and functional problems. Hence, physiotherapy can help them overcome these issues.

Special education

Children with Down syndrome can have a variety of issues which can affect their learningcapability. These children need individual attention. Hence, special educators should work along with the parents to develop an Individualized Education Program (IEP) for the child.It is important for teachers to take into consideration the degree of intellectual disability involved, the child's talents and interests, and the supports and services he or she needs, as specified in the IEP. Generally speaking, teachers will find it more effective to emphasize concrete concepts with a student who has Down syndrome, instead of abstract ideas. Teaching skills in a step-by-step fashion with frequent reinforcement and consistent feedback has proven successful.

Teaching strategies involve:

- Pairing children with Down syndrome with other children who can assist them in their activities.
- Minimizing distractions would help the child in focusing.
- Students with Down syndrome have strong visual learning modalities. Visual demonstrations, pictures and illustrations should be used to assist in providing effective instruction.
- Children should be allowed to 'observe' what is going around without compelling them to actively interact.
- Childs name should be frequently called so that they feel included and know that they are being addressed.
- Physical activities such as bouncing a ball should also be included in the sessions so that children are alert. These activities also improve their fine motor skills.
- Communication and language skills can be improved taking to them in simplified, short and clear sentences and by playing games and sharing books.
- This may also improve their imagination power and creativity.
- Verbal feedback and praise should always be given to the children suffering from Down syndrome so that they get motivated.

Occupational therapy

Occupational therapist help children with Down syndrome to master skills required across life span. They help them to become independent in selfcare skills, improve fine and gross motor skills, preparing for school and improving participation in play and



leisure activities. They also help their families to develop goals that are appropriate to the child's capability. Occupational therapy is usually implemented immediately after the diagnosis has been made. It helps in developing appropriate cognitive-perceptual skills and if required providing adaptive devices such as reading aids, writing aids, memory aids, etc.

Stem cell therapy

Stem Cell Therapy is currently being used to tackle the neurological problems of Down's Syndrome. Administration of stem cells may help in neurogenesis (making new neurons), angiogenesis (new blood vessels) and synaptogenesis (new synapses) which further helps in restoring the brain damage. Stem cell therapy cannot correct the characteristic physical deformities but can improve physical functioning of the body by improving nerve supply to the muscles. It has been seen that stem cell therapy can improve cognition, understanding, learning and activities of daily living. Though not a cure, as genetic defect cannot be repaired, stem cell with rehabilitation therapy can help these children towards independent living.

Chapter 6

Learning Disability

"Inability of the brain to memorize"

Learning is a process that is consistent with a child's growth and development. When there is a deficit in learning, it calls the attention of parents and teachers. These are the children with Learning disabilities and it is one of the main causes for school failures in majority of children nowadays.

The term "Learning disability" was first used and defined by Dr. Samuel Kirk in 1963 in order to describe children who have serious learning problems in schools but do not fall under other categories of handicap. It is a neurologically based processing problem which can interfere with learning basic skills such as reading, writing, and/or math. They can also have difficulties in performing higher mental functions such as organization, time management, abstract thinking, attention and memory. Learning disability will not only affect a child's academics but also his personal and social life.

Learning disabilities is an umbrella term used to describe a set of impairments in the areas of acquisition and use of listening, speaking, reading, spelling, writing and reasoning skills.

The different types of Learning disabilities include:

- Dyslexia (difficulty in reading)
- Dysgraphia (difficulty in writing)
- Dyscalculia (difficulty in numbers and mathematical concepts)
- Dysnomia (difficulty in naming)
- Dysphasia (expressive language difficulty)
- •

Children with LD will display one or more of the following characteristics:

- Perceptual problems
- Limited ability to abstract and generalize
- Difficulties with memory and attention
- Slow speech and language development
- Limited social skills
- Inappropriate/ immature personal behaviour
- Limited attention span and poor retention ability
- Decreased motivation, Poor self-confidence and Low self esteem
- General clumsiness
- Lack of coordination of gross and fine motor skills
- Emotional disturbances

MRI

Most of the patients with learning disability show normal MRI brain.



MRI showing normal brain structure in LD

FDG-PET

PET scan of the LD patient showing abnormalities in the frontal cortex, medial temporal cortex and cerebellum. The blue region reflects hypometabolism (which means decreased metabolism or low functioning regions or underconnectivity), red or white reflects

hypermetabolism (which means increased metabolism or high functioning regions or over connectivity), green reflects normal brain glucose metabolism.



FDG-PET image of a LDpatient showing damage in frontal cortex, medial temporal cortex and cerebellum

Multidisciplinary rehabilitation combined with newer treatments like stem cell therapy may help in treating the disorder at a cellular level. The rehabilitation techniques will manage the symptoms while stem cell therapy will address the core neuropathology of learning disability.

Speech and Language therapy:

A child with learning disability may have trouble in speech and writing. Problems can occur in the production, comprehension, and awareness of language at the sound, syllable, word, sentence, and discourse levels. Individuals with reading and writing problems may also experience difficulties in using language strategically to communicate, think, and learn. Thus, speech and language intervention should target both spoken language needs along with writing issues. The therapy activities used for a child with LD are always linked to the school work. Therefore, materials for treatment are taken from or are directly related to content that has been taught in class (e.g., school language textbooks for reading activities, essay writing or school assignments for writing activities). Social interactional skills and other pragmatic skills like topic initiation and topic maintenance also taught which will help the child in communicating with others more confidently.

Psychological Intervention

Intervention for children with learning disability involves a review of all the aspects of child's functioning rather than one individual aspect. Therefore, the assessment involves cognitive, emotional, inter-personal, intra-personal, personal independence and self-care skills together. Typically, psychological interventions involve the development of Individual Educational plans and



Individual Care plans. Psychologists also provide family support which involves working with the parents, teachers, guardians and siblings and it also involves enabling families to understand and provide for their affected family member's emotional and social needs and acknowledge the child's developmental level. It can be helpful to reduce the isolation that can sometimes occur with having a family member with a learning disability.

Special Education



Children with learning disabilities have limited ability to acquire, store, organize and use skills and knowledge. Their memory, auditory, visual, and linguistic information processing is also affected. Special educators help these children by introducing special teaching techniques, visual and memory aids, classroom modifications and use of technology. This may help the children in improving their learning.

Teaching Techniques involve:

- Providing handouts and visual aids.
- Teaming a reader with a non-reading student during in-class assignments.
- Using more than one way to demonstrate or explain information.
- When possible, information should be broken into small steps when teaching many new tasks in one lesson
- Stating objectives, reviewing previous lessons and summarizing periodically.
- Allowing time for clarification of directions and essential information.
- Providing study guides or review sheets for exams.
- Providing alternative ways for the students to do tasks, such as dictations or oral presentations.
- Providing assistance by proofreading written work.
- Stress on organization and ideas rather than mechanics when grading in-class writing assignments.
- Allowing the use of spell-check and grammar-assisted devices.
- Taking students help to understand his needs and modify the techniques accordingly.
- Allowing the student the same anonymity as other students (i.e., avoid pointing out the student or the alternative arrangements to the rest of the class).

Physiotherapy

Children with LD may have other comorbid conditions in which their motor activities might be affected. Physical exercises may help in addressing these issues. Exercise may also help these children to stay calm and concentrate in their activities.

Occupational Therapy

Occupational therapist is usually a part of interdisciplinary team and are involved in helping children with learning disability to adjust in different roles across life span. The intervention involves the patient, the environment in which he/she needs to perform occupations, their family members and significant others. It can be an individualized therapy, or in a group setting or can be in the same environment where he/she needs to perform the task. Occupational therapists mainly focus on ADLs, learning, work, play and leisure, social participation, developing cognitive-perceptual skills, developing adaptive techniques and devices to improve learning and addressing other associated problems.

Stem Cell Therapy

As discussed above, LD is a neurological disorder. In simple words, the wiring of the brain is disturbed. Defect in myelination is also noted in LD, which affects the signalling and information processing in these children. Learning occursthrough a network of brain cells, and defects in any part of this network will cause learning disability. Stem cells can repair this network by various mechanisms. Scientific studies haveshown that stem cells also secrete brain derived neurotrophic factor (BDNF) which influences the development of patterned connections in the brain leading to improved learning. Stem cells can enhance the speed of learning and thereby augment academic performance in children with LD.

Chapter 7

Global Developmental Delay (GDD)

"Brain controls global development of a child"

Global Developmental Delay (GDD) is an umbrella term which is used when children have significant delay in two or more of the following developmental areas: gross/fine motor, speech/language, cognition, social/personal, and activities of daily living. GDD can have either genetic or acquired causes.

1. Genetic causes: Metabolic disorders, i.e. storage diseases, phenylketonuria, urea cycle disorders, etc. Down's syndrome, Fragile X syndrome, Rett's syndrome, Prader-Willi syndrome, Angelman syndrome, Cri du chat syndrome, etc

2. Acquired causes:

A. Prenatal or perinatal causes (before or at birth): Exposure to teratogens or toxins (tobacco, alcohol, illicit drugs), intrapartum asphyxia, prematurity, congenital infections, congenital hypothyroidism - normally picked up on newborn screening, trauma, intracranial hemorrhage.

Therefore, it is important to put a child with GDD on an early intervention program to help him grow optimally and to prevent further complications.

B. Postnatal causes: Infection (meningitis, encephalitis), cranial trauma, environmental causes such as poor nutrition, family stress, child abuse or neglect, etc.

Following are common signs of GDD:

- Inability to achieve milestones on time for example inability to sit on the floor without support by 8 months, crawl by 12 months
- Fine/gross motor difficulties
- Poor muscle tone
- Facial dysmorphic features: wide nasal ridge, low set ears, wide forehead, protruding lips, etc
- Feeding difficulty
- Poor social skills/ judgement
- Speech delay and communication problems
- Behavioral issues: hyperactivity, aggressiveness, stubbornness, easy irritability, etc
- Sensory issues: craving for movement, rocking, pressure seeking, aversion to touch, loud sounds, etc

MRI in GDD provides an information regarding brain tissue structures and anomalies.



Atrophy of the temporal cortex

MRI showing structural damage in GDD

PET CT scan

GDD affects functioning of the brain globally and therefore multiple regions show decreased function on PET CT scan brain. All four lobes i.e. frontal, parietal, occipital and temporal along with cerebellum may be involved at varying degrees.



FDG-PET image of a GDD patient showing damage in frontal, temporal, parietal, occipital cortex and cerebellum.

Children with GDD can benefit from an array of treatment options available which broadly include medical, rehabilitative and newer treatments like stem cell therapy.

Medical treatment: includes administration of medicines to eliminate toxic metabolites to compensate for metabolic deficiencies. Calcium and vitamin supplements also help in development of these children.

Surgery

Children with GDD may develop contractures of muscles resulting in limited joint range, joint and bony deformities such as scoliosis, dislocation of hip, etc which need corrective surgery like tendon release, corrective osteotomy. These surgeries are performed by pediatric orthopedic surgeons.

Rehabilitation:

Rehabilitation plays a vital role in managing the physical and cognitive impairment thereby providing optimum quality of life by improving functionality, self-care, and independence. Thus, it helps children with GDD live a sound mental, emotional, academic, and social life.

Physical therapy:



Physical therapy helps restore, maintain and promote optimal movement and physical function. Physiotherapists use techniques such as NDT, Bobath, Rood's approach, stretching, gait training, selection of appropriate aids and orthosis to achieve the above goals. Thus, if a child with GDD shows physical impairments, physical therapy forms integral part of his/her rehabilitation.

Occupational therapy

Occupational therapy identifies problems that a child faces in day to day tasks and addresses them so as to enable the child to carry out complex movements involved in daily tasks such as bathing, dressing, transferring to the toilet, etc. Also, parents and caregivers are educated for possible modifications which can be done to assist the child in a functional activity. Thus, occupational therapy helps boost children's self-esteem and confidence, which in turn helps them to become independent in their daily activities. This not only improves the quality of life of the child but also of the caretakers.

Speech and swallowing therapy

Children with GDD may have difficulty in speech and language development, and many a times experience difficulty with facial expressions and hand gestures. Speech therapy thus aims at improving oromotor, speech and language skills. Children who cannot speak, are taught sign language, or how to use special equipment like computer/tablet for communication through pictures, etc. A speech therapist also provides guidance regarding hearing aids if hearing deficit is the cause of delayed speech. Children with GDD may also suffer from chewing and swallowing difficulties. Thus a speech therapist teaches these children and caregivers swallowing techniques, appropriate positioning and oromotor exercises, makes dietary changes as in the consistency of food (soft/liquid/mashed), etc.

Psychological Intervention

Intervention in Global Development Delay involves a psychological assessment where an in-depth interview is conducted with the parents. They are asked questions regarding their child's functioning, including appropriate social and play skills, language and communication skills. Children are also tested for motor skills, and academic skills by either giving them different tasks or observing them in their natural environment. Tests are conducted to calculate social quotient (SQ) or Developmental Quotient (DQ) of the child. Parent training is also conducted regarding level of exposure to be provided which can enhance the development of the child.

Special Education



Children with global developmental disorders can have a variety of issues that can affect their learning. They should have an individualized education plan (IEP) that addresses their areas of delay and contains goals specific to each domain in which they have a delay. The teaching strategies and interventions depend on the behavior and performance on the child along with the age.

Special educators should include the following strategies:

• **Provide structured opportunities for student to participate in social interactions:** Children with GDD may excel in more creative areas of the curriculum, such as drama, art or music. By incorporating a healthy degree of challenge and encouraging them to participate as part of the whole class would allow them to demonstrate their skills to both their peers and an adult. Realistic and manageable targets should be set to improve their skills and understanding

- Use strategies to make directions and learning expectations clearly understood: Children learn by watching and listening, so assistive technology can be used to teach them. Playing games or sharing books to improve communication and language skills whilst simultaneously promoting creativity and stimulating imagination. A visual display of tasks will enable them to understand expectations and a daily visual timetable will ensure they are not alarmed by sudden changes in routine etc.
- Seating Arrangements: Seating arrangement of the child should be free from distractions. For example, do not seat the student next to a window facing the playground. Pairing them with a capable partner who can assist with keeping the student on track without affecting his own education would be beneficial. Discussion: Developmentally delayed children may have speech or language difficulties. Engaging in frequent discussion is an effective strategy.
- Special educators should always give verbal feedback, praise them and call the child's name frequently to ensure they feel included and know they are being addressed.

Stem Cell Therapy

In GDD, neuronal cells are either lost or damaged affecting the brain development in these children. Stem cells migrate to the damaged areas, differentiate and replace the lost and damaged cells. This improves the lost neuronal functions. It also improves blood supply (oxygen) to the brain. Another important mechanism of stem cell is to reduce inflammation and brain injury. By reinitiating the development of the brain, stem cell therapy can aid to achieve developmental milestones in these children. Stem cell therapy with rehabilitation can improve ambulation, hand activities, speech, understanding and swallowing etc. The repair of damaged brain can be visualized at cellular level in PET CT scan. The aim of stem cell therapy is to improve brain function, support standard rehabilitative therapies and make these children as normal functioning as possible.

Chapter 8

Cerebral Palsy

"Abnormal brain signals to the muscles"

Cerebral palsy is a condition with several neurological complications that affects the brain development in infants. It causes abnormal movement in different parts of the body and varies in severity. The word cerebral refers to cerebrum which is responsible for motor function (movement) and palsy refers to paralysis of voluntary movements causing problems with gait, posture, muscle tone and in coordination. The worldwide prevalence of CP is 1.5 to 4 per 1000 live births.

Cerebral palsy is caused by damage to the fetal or infant brain which can occur either in the intrauterine period or during birth or during or within first 2 years of life. Infants born prematurely are at a higher risk of developing CP because of inadequate development of brain. Poor maternal health, abnormal deliveries, maternal diabetes or high blood pressure also pose a high risk for occurrence of CP.

CP is classified based on the type and location of movement problems. There are also different levels of severity among each type of cerebral palsy. The 4 main types are Spastic, Athetoid / dyskinetic, Ataxic and Mixed CP. Based on number of limbs involved CP is classified as **Monoplegia**, **Diplegia / Paraplegia**, **Hemiplegia** and **Quadriplegia**

Symptoms of CP:

Symptoms of CP differ in every child. Some symptoms are very mild while some are more intense. The severity of symptoms depends on severity of brain damage.

The most common signs of cerebral palsy are:

- Problems with movement on one side of body
- Stiff muscles
- Exaggerated or jerky reflexes
- Involuntary movements or tremors
- Lack of coordination
- Poor balance
- Drooling
- Problems swallowing or sucking
- poor speech (dysarthria)
- Seizures
- Contractures (tightning / shortening of muscles)
- Delayed gross and fine motor skills
- Incontinence
- Gastrointestinal problems

Secondary complications:

Damage to the developing brain can cause various other health complications, in addition to CP. There are a number of Secondary complications that occur more frequently in those with cerebral palsy such as;

- Epilepsy
- Vision or hearing impairments
- Learning disabilities
- Autism spectrum disorder (ASD)
- Attention deficit hyperactivity disorder (ADHD)
- Speech disorders
- Mental health disorders

MRI

Children with CP have abnormal MRI brain findings as it is associated with the structural damage. White matter damage including periventricular leukomalacia (PVL), diffusevolume loss involving white and gray matter, gliosis (scarring), enlarged ventricles, abnormalities in corticospinal tracts, basal ganglia and thalamus are the most common findings in patients with CP. The main neuropathology seen in affected preterm infants is PVL. PVL is causedby damage to the endogenous stem cells around the ventricles.



MRI showing structural damage in CP

PET CT scan

The cerebral palsy (CP) is not associated with a specific region of the brain abnormalities. Any area of the brain can be damaged depending upon the cause and severity of injury.



FDG-PET image of a CP showing damage in cortex and cerebellum.

Treatment for CP should focus on improving the quality of life of the child. Active management of the symptoms that co-exist with CP is the best way to ensure the highest quality of life for a child as they transition into adulthood.

Occupational Therapy

Occupational therapy for CP mainly focusses on teaching handling techniques to the parents, positioning of the child, normalization of muscle tone, prevention of contractures and deformities, use of splints and adaptive devices, improving cognitive functions, facilitating normal development of the child, developing fine motor skills, functional skills and play behavior, improving strength of upper body and shoulders and home and environmental modifications. It also involves use of assistive technology like electric wheelchairs, voice amplifiers, modified key board, adapted switch board, electric shaving machine, electronictooth brush, Communication devices like iPad, tablets, computers which make lot of difference in improving quality of life of the these children.

Speech-language therapy



Children with cerebral palsy often have communication difficulties, delayed speech and language development. They have Dysarthria (a motor speech disorder) that makes it difficult for them to speak clearly due to poor muscle tone and lack of coordination in oral facial, neck and throat muscles. Muscle weakness or spasticity in CP leads to difficulty in articulating sounds,poor respiration and speech incoordination. All their oromotor activities are affected. Some children might also

have hearing loss, which can further complicate communication and contribute to speech and language delays.Speech and language therapy will help children speak clearly, communicate effectively, and control the muscles involved in speaking, eating, drinking, and swallowing. It also helps in building a child's vocabulary, listening skills, interpretation, or capacity to communicate through non-verbal means.

It aims at improving the child's ability to effectively communicate their thoughts and ideas to the world. Communication skills are important aspect of interacting with others, developing relationships, learning, and working. Speech therapy increases a child's potential for independence and positively impacts their quality of life.

Psychological Intervention

Many children with Cerebral Palsy struggle with psychological issues especially if they are unable to ask for assistance, socialize like others or have difficulty in communicating their needs. Psychologists implement Cognitive-Behavioral Approach which teaches the child to interact with their environment and gain control over their emotions. Once the child learns to communicate appropriately s/he is able to enjoy daily life activities, involve more with family and peers which improves their quality of life. Psychologists also work with the physical therapists to encourage the person to exercise by rewarding desired outcomes and discouraging negative behaviors and thoughts. Individual counseling sessions are provided by a Psychologist to help them overcome with feelings of Inadequacy and meaninglessness. These feeling are substituted by building their own values, self-worth and accomplishment. Apart from this, Psychologists actively work with the caregivers and family members and guide them regarding how to manage their emotional and aggressive issues if any, and how much level of exposure is required to increase their quality of life and overall development. Family counselling is crucialfor proper management.

Special Education

Education is one of the most fundamental aspects of development for children with cerebral palsy. These children face many challenges in school and are likely to need individualized help. It is important to have an Individualized Educational Plan (IEP) for these children to set their learning goals.

- Special educators should consider the posture and movement abilities of the children and make them comfortable so that they learn better.
- Taking into consideration the child's capability and limitation, the educational program should be conducive for learning. Unrealistic expectations can be frustrating for the child as well as the parents.
- Children with CP should keep changing their positions to prevent tightening of the muscle.
- Teaching children with therapeutic assistance and access to modification in the class is beneficial.
- Equipment needs are extremely important, as proper positioning can facilitate eye-hand coordination and improved motor control.
- Patience is a key factor when working with children with CP, as studies have shown that these students take longer to respond than their neurotypical peers.
- Teachers should maintain open communication with the child's family to encourage carry-over regarding home programs and recommendations.

Physiotherapy

Physiotherapy plays an important role in managing a child with cerebral palsy as soon as the child is diagnosed. It helps the child in achieving the right posture and also in sitting, standing and walking. It improves spasticity, prevents deformities, strengthens muscles, improves balance, neck control and trunk control. It helps the child achieve



motor milestones. The therapy approach mainly used is based on the Neurodevelopmental Treatment (NDT) techniques which focuses on goal based functional outcome.

Stem cell therapy

In cerebral palsy, the neuronal cells are dead or damaged due to the brain injury. This results in loss of neuronal functions in children with CP. Stem cell therapy helps in repairing the brain damage by replacing the lost/damaged cells. It improves blood and oxygen supply to the brain by forming new blood vessels. It reduces inflammation, improves brain plasticity and thus helps restore the lost neuronal functions as evident on PET CT scan.Stem cell therapy studies in children with CP have shown improvements in spasticity, gait, balance, posture, gross and fine motor activities, voluntary control, swallowing and speech. Thus, Stem cell therapy helps in development of the child and should be used as add on treatment to standard management.

Chapter 9

Neuromuscular Disorders

"A dangerous combination of damage to nerves and muscles"

Neuromuscular disorders are a group of disorders affecting theperipheral nervous system and skeletal muscles. This includes muscles, nerve-muscle junction called the neuromuscular junction, peripheral nerves and the motor nerve cells in the spinal cord.

Based on the primary area of involvement they are classified as:

- muscle diseases,
- disease of motor neuron or anterior horn of the spinal cord,
- neuromuscular junction diseases, and
- peripheral nerve disorders.

These disorders tend to be progressive in nature and currently have no known cure. Treatment goals include managing the symptoms, delaying disease progression and improving the quality of life of individuals afflicted with the disorder.

Symptoms of neuromuscular disorders include

- Muscle weakness and wasting
- Altered muscle tone
- Numbness
- Tingling
- Twitching
- Spasms
- Muscle pain
- Joint movement restrictions
- Muscle stiffness and joint deformities
- Droopy eyelids
- Double vision
- Recurrent infections
- Difficulty with breathing and, p oor feeding and swallowing difficulties.

In this chapter, we have focused on two neuromuscular disorders namely muscular dystrophy and spinal muscular atrophy (SMA).

Muscular dystrophy

Muscular dystrophies are a group of genetic disorders caused by a faulty or absent gene which results in interference with the production of proteins that are responsible for maintaining muscle health. Muscular dystrophies are characterized by progressive muscle weakness and atrophy of different muscle groups. The progressive decline in muscle strength results in progressive functional decline and interference with activities of daily living making the affected individuals dependent on their caregivers. There are several types of muscular dystrophies based on the distribution of muscle weakness of which Duchenne Muscular Dystrophy (DMD) is the commonest type. Parents / teachers might notice delayed acquiring of milestones, abnormal enlargement of calf muscles, weakness of the buttock muscles which presents as difficulty in rising from the floor and is typically seen as child using his hands in a manner as if trying to climb over himself to stand up from the floor (Gower's sign), walking on toes, frequent falls, difficulty with running and jumping.In DMD children lose walking ability by 10-13 years of age. Further progression results in joint deformities, abnormal spine curvature, breathing problems, weakening of the heart muscles leading to cardiac problems, swallowing and feeding troubles. Fatality is the imminent outcome of most forms of the disease, with children with DMD being able to survive into their late teens to early 20s only.

MRI has become a valuable imaging in detecting patterns of muscle involvement in various muscular dystrophies and other inherited myopathies. Such a technique provides a high soft tissue contrast allowing excellent assessment of striated muscles concerning shape, volume (atrophy, hypertrophy), fatty infiltration and tissue architecture.



Fatty infiltration

MRI of the MD patient showing fatty infiltrationand preserved muscle

Preserved muscle

Spinal muscular atrophy (SMA)

SMA is a genetic disorder and is classified into different types based on the age of symptom onset. It is characterized by degeneration of the anterior horn motor neurons in the spinal cord which leads to progressive muscle weakness and paralysis. It is one of the leading causes of infantile mortality.

Diagnosisof neuromuscular disorders is established by

- Clinical picture and Neurological examination
- Electromyography which records the electrical activity of muscles
- Nerve conduction studies to test the signals from nerve to muscle
- Muscle biopsy
- Genetic testing
- ECG to assess heart muscle involvement
- Musculoskeletal MRI
- Blood test to check for raised enzyme levels.

Treatments available for neuromuscular disorders

There is no cure and management is mainly supportive. It includes medications, physical therapy, occupational therapy, special education, psychological intervention and if necessary, surgery.Newer treatments are being explored to achieve satisfactory results and these include gene therapy and stem cell therapy. Gene therapy attempts to introduce the gene to enable production of the deficient protein, but is faced with safety issues. Stem cell therapy increases the repair capacity of the damaged muscles and can slow the progression of the disease, retain function for a longer time and increase survival time.

Medical Intervention

Medical intervention includes treatment of the symptoms, corticosteroids (or steroids) which can help slow disease progression in DMD. Medicines are also used to prevent and/or manage respiratory and cardiac complications.

Corrective Surgery

Surgery may be needed to correct deformities such as spinal curvature which makes breathing more difficult. Surgery can sometimes relieve muscle shortening.

Special Education

Children with neuromuscular disorders are faced with orthopedic problems, disabilities, and/or learning disabilities with difficulty in their ability to read, write and comprehend. Children with learning disabilities may need special education. Other children who do not require special education may be enrolled in normal schools with required support. An individualized education plan (IEP) or other special plans may need to be administered. When planning IEP, special attention needs to be paid to the following areas:

- Setting goals based on the requirements of the student in collaboration with therapists and his/her parents
- Use of assistive devices advised by a Physical or Occupational Therapist
- Seating students in a way as to promote involvement of the child and providing for larger desks etc. to provide room for wheelchairs
- Planning lessons to impart personal care, social skills, etc.
- Planning activities that ensure involvement on part of the student
- Providing longer duration to complete tasks and allowing for frequent breaks to avoid fatigue

Speech therapy

Children with neuromuscular disorders often have voice difficulties with unclear speech. They commonly have "Dysarthria" (a motor speech disorder) that makes it difficult for them to speak clearly. This happens due to poor muscle tone and lack of coordination in orofacial, tongue, neck and throat muscles. They also have difficulty articulating sounds correctly due to muscle weakness. The goal of speech therapy is to help these children speak clearly, communicate effectively, and develop control in the muscles that are involved in speaking, eating, drinking, and swallowing.

Psychological Intervention

Children suffering from Neuromuscular Disorders require an adequate rehabilitation program that can help maintain their quality of life and maximize their physical and psychosocial functioning. Psychosocial functioning involves emotional, behavioural and social aspects and are believed to be central to an individual's quality of life. Psychologists make plans that are aimed at increasing motivation and will power. Psychological intervention can contribute in the areas of disruptive and obsessive-compulsive behaviors that may be present. Psychologists also conduct anxiety and depression scales to assess severity of distress faced by children with Neuromuscular Disorders and provide intervention where needed. Family support groups are created to help parents share and learn from other parents and caregivers which in turn can help them to embrace their child's life. In very severe cases, anti-psychotic medications to treat co-morbid mental illnesses such as schizophrenia, bipolar disorder, depression, mania and severe anxiety are advised.

Physical Therapy



The main goal of physiotherapy is to maintain and strengthen the muscles in children with neuromuscular disorders. It helps the child achieve optimum function in the associated disabilities. It includes management of contractures, scoliosis and other deformities thus preventing secondary complications. Physiotherapy also helps these children maintain ambulation.

Occupational Therapy

As physical abilities change, occupational therapy can help patients with neuromuscular disorders relearn these movements and abilities. Occupational therapy also teaches patients to use assistive devices such as wheelchairs and utensils. The main aim of occupational therapy is to maintain and improve functional independence, maintain ambulation and mobility of the patient, energy conservation and work simplifications, home and environmental modifications.



Stem cell therapy

Stem cell based therapies hold promise in treating incurable neuromuscular disorders. Stem cells have an ability to renew and differentiate into neuronal and muscle cells. In neuromuscular disorders these cells are either damaged or dead causing muscle and functional loss. Stem cell therapy helps by replacing these cells. Stem cells also secrete neurotrophic and growth factors which aids muscle repair and thereby, slows the progression of the disease. Individuals undergoing stem cell therapy can retain their function and independence for a longer time, thus improving their quality of life. By injecting cells into the motor points of the weak muscles, one can restore lost neuromuscular functions, thereby slowing down disease progression, prolonging ambulation and life span in these patients.

Chapter 10

Other Neurological Disorders

"Brain is the master of the body"

In the earlier chapters, we have discussed the neurological and neuromuscular disorders commonly seen in children. In this chapter, we have briefly described other disorders such as spina bifida, transverse myelitis, ataxia, head injury and spinal cord injury.

Spina bifida

Spina bifida (SB) **is when a baby's spine and spinal cord do not develop appropriately in the womb, causing a gap in the spine** resulting in the incomplete closure of the posterior components of the vertebrae. It is the second most common cause of childhood disability after cerebral palsy. It's not known what causes spina bifida, but a lack of folic acid before and in the early stages of pregnancy is a significant risk factor. Myelomeningocele, Meningocele, Spina Bifida Occulta are common types of SB. Most cases of spina bifida are detected during the mid-pregnancy anomaly scan, which is offered to all pregnant women between 18 and 21 weeks of pregnancy.

Symptoms of spina bifida

- Weakness or total paralysis of the legs
- Bowel incontinence and urinary incontinence
- Loss of skin sensation in the legs and around the bottom the child is unable to feel hot or cold, which can lead to accidental injury
- Many babies will have or develop hydrocephalus (a build-up of fluid on the brain), which can further damage the brain. Hydrocephalus can cause additional symptoms soon after birth, such as irritability, seizures, drowsiness, vomiting and poor feeding.
- Most people with spina bifida have normal intelligence, but some have learning difficulties.

Transverse myelitis

Transverse Myelitis is a rare condition of the central nervous system which includes inflammation in the spinal cord. The spinal cord carries nerve signals to and from the brain through nerves that extend from each side of the spinal cord. The segment of the spinal cord at which the damage occurs determines which parts of the body are affected. Damage at one segment will affect function at that level and below. The inflammation can harm or destroy the myelin sheath which protects the nerve cell fibers thus hamper the signaling. It may be caused due to immune system disorders, viral, bacterial or fungal infections. The yearly frequency of transverse myelitis ranges from 1.34 to 4.60 cases for each million.

Symptoms

- Classical features of transverse myelitis are:
- Sudden acute weakness of the legs or arms
- Pain
- Abnormal sensations such as burning, tickling, pricking, numbness, coldness, or tingling in the legs, and sensory loss. Abnormal sensations in the torso and genital region are common.
- Bowel and bladder dysfunction.
- Muscle spasms
- A general feeling of discomfort
- Headache
- Fever
- Respiratory problems

Ataxia

Ataxia means without coordination. Ataxia is a symptom resulting from lack of

muscle control or coordination of voluntary movements. It may affect the fingers, hands, arms, legs, body, speech, and even eye movements. There are many different types of ataxia, but in children the most commonly seen types are hereditary ataxia.

Symptoms of ataxia

Symptoms and time of onset may vary according to the type of ataxia. Typically, the most common include:

- Balance and coordination are affected first
- Poor coordination of hands, arms, and legs
- Slurring of speech
- Wide-based gait (manner of walking)
- Difficulty with writing and eating
- Slow eye movements
- Spasticity
- Tremor
- Pain
- Fatigue
- Bowel or bladder dysfunction
- breathing trouble, or choking which can lead to death

MRI: It can define structural disturbances and monitor disease progression. MRI of the Ataxia patients show atrophy in the cerebellar cortex.



MRI showing damage in the cerebellum

FDG-PET

Most of the Ataxia patients shows abnormalities in the cerebellum.



FDG-PET image showing damage in cerebellum.

Spinal cord injury

A spinal cord injury is damage to the spinal cord which results in temporary or permanent loss of motor, sensory, or autonomic functions. The spinal cord is responsible for carrying signals back and forth between body and brain. These signals get disrupted due to the injury. Injuries can occur at any level of the spinal cord and can be classified as complete injury where there is total loss of sensation and muscle function, or incomplete where some nervous signals can travel past the injured area of the cord. It's an extremely serious type of physical trauma that's likely to have a lasting and significant impact on quality of life of the injured patient

Symptoms

- Muscle weakness or paralysis in the trunk, arms or legs
- Loss of feeling in the trunk, arms, or legs
- Muscle spasticity
- Breathing problems
- Problems with heart rate and blood pressure
- Loss of control of the bladder or bowels
- Feelings of spreading numbness or tingling in the extremities
- Unconsciousness
- Headache
- Pain, pressure, stiffness in the back or neck area
- Signs of shock

MRI imaging is critical to the assessment because it clearly depicts lesion location, extent, and severity.



MRI of the SCI patient with injury at the level of D9-D10

Traumatic brain injury

Traumatic brain injury (TBI) is a form of brain injury caused by sudden damage to the brain. Its usually a result of road traffic accident, falls, sports related accidents or gunshot incidents.TBI can result in physical, cognitive, social, emotional, and behavioral symptoms, and outcome can range from complete recovery to permanent disability or death. Severity depends on the extent of brain damage that has occurred.

Symptoms

Symptoms of TBI may or may not appear until days or weeks following the injury.

Symptoms of mild TBI are

- Headache
- Light-headedness
- A spinning sensation
- Mild confusion
- Nausea
- Temporary ringing in the ears

The symptoms of a severe head injury include many of the symptoms of minor head injuries along with the following

- Loss of consciousness
- Seizures
- Vomiting
- Balance or coordination problems
- Serious disorientation
- An inability to focus the eyes
- Abnormal eye movements
- A loss of muscle control
- A persistent or worsening headache
- Memory loss
- Changes in mood

MRI is very sensitive and accurate in diagnosing cerebral and cerebellar pathology in TBI patients.

Gliosis of the frontal cortex



MRI showing damage in the cortex of the TBI patient

PET CT scan

PET CT scan shows the areas of the brain that are damaged due to trauma and the severity of damage



FDG-PET image of a TBI patient showing damage in frontal-parietal cortex and occipitaltemporal cortex.

All the above mentioned neurological disorders have no treatment. However, medications, surgical intervention and rehabilitation techniques are able to manage the symptoms and control the worsening of the disorder. Stem cell therapy has also shown great potential in addressing the underlying neuropathology of these disorders.

Physiotherapy



Physiotherapy helps in retaining muscle strength and flexibility, enhance coordination, reduce spasticity, regain greater control over bladder and bowel function, and increase joint movement. It can also help to reduce the likelihood of pressure sores developing in immobilized areas. Individuals are also taught to use assistive devices such as wheelchairs, canes, or braces as effectively as possible.

Occupational therapy

Occupational therapy provides the affected children with better approaches to keep up or modify their independence by participating in meaningful, self-directed, everyday tasks such as eating, bathing, toilet activities, dressing, transfers, etc. Therapists show individuals how to function at the highest level possible, by developing coping strategies, suggesting changes in their homes to



improve safety (such as installing grab bars in bathrooms), and changing obstacles in their environment that interfere with normal activity.

Speech Language Therapy



Children with ataxia, head injury, spina bifida with hydrocephalus may have difficulty in speech and swallowing. They may suffer from a motor speech disorder that makes it difficult for them to speak clearly due to poor muscle tone and lack of in coordination in oral facial, neck and throat muscles. The role of a speech therapist is to help these children speak clearly, communicate effectively, and control the muscles involved

in speaking, eating, drinking, and swallowing. Speech therapy can improve oral-facial muscle tone and coordination of articulators for improving speech intelligibility/ clarity as well as improving oral sensory awareness, reduce drooling and solve the problem of tongue thrust.

Special Education

Neurological disorders including traumatic brain injury, ataxia, spina bifida and transverse myelitis present with challenges to both students and schools. Individuals with TBI may have an associated impairment of cognition, language, memory, attention, sensation and motor abilities. Individuals with spina bifida usually have impaired perceptual motor skills and may have poor eye-hand coordination, handwriting and self-care skills. Transverse myelitis may lead to physical limitations making learning difficult for these children. Individuals with ataxia face difficulties in writing tasks, attention and concentration and social skills.Hence, role of a special educator is to assess these children with respect to their basic learning abilities including attention, problem solving, reasoning, and memory and provide them with an intervention will promote independence and self-care skills and enable them to make decisions and choices.

Taking into consideration the strengths and needs, an IEP is developed specifically for the individual student.

- Strategies and principles for teaching individuals with these neurological disorders include:
 - Use of skimming and scanning to train eye movements
 - Allowing students to record lessons
 - Assistance from related services
 - Incorporating activities that improve coordination
 - Furniture modifications, assistive devices to accommodate disabilities
 - Assigning work buddies to help with assignments, projects and experiments
 - Promote social relations
 - Provide adequate time for task completion
 - Use of alternative strategies to impart teaching. Children learn by watching and listening. Making use of audio-visual tools.

- Use of photographic evidence of participation and progress can be relevant and useful.
- Frequent calling out of child's name to ensure they feel included, giving them a sense of belonging and to promote participation.
- Make use of physical activity in learning sessions. This helps develop gross and fine motor skills. Activities could include bouncing a ball, sitting and bouncing on a gym ball or going outside.
- Playing games or sharing books improves communication and language skills, stimulates creativity and imagination.
- The TEACHH approach to curriculum tasks maybe beneficial in consolidating taught skills and encourages independence.
- ▶ Use of a sand clock encourages a sensible pace and time spent on each activity.
- Introducing lessons on personal care.

Stem cell therapy

Stem cell therapy has shown promising results in neurological disorders. Due to the ability of stem cells to self-renew, multiply and differentiate into neuronal cells, it is able to work at cellular level and replace the damaged cells. It restores the neuronal connectivity and thereby neuronal functions by remyelination, angiogenesis, synaptogenesis and neurogenesis. It decreases the inflammation and regulates the immune system. Through paracrine mechanisms, stem cells also halt further cellular damage. Thus, in progressive neurological disorders where there is continuous ongoing neurological damage, the aim of stem cell therapy is to slow down or halt the progression of the disease. In static neurological disorder where there is only one time damage, the aim of stem cell therapy is to maximize repair and reversal of symptoms (minimize the gap between current neurological deficit and normal function)

Section B: Multidisciplinary Treatment
Medical Management of Neurological Disorders

"Seek early medical advise for better outcome"

Neurological disorders in children need a multidisciplinary approach and management. Early identification of a disorder and intervention is the key to a better outcome and alleviation of parental anxiety. Certain behavioural issues and associated conditions like seizures can be treated with medications and can be referred for doctor's opinion.

Here described are few conditions we see day in and out and can be screened by the special educator for medical management.

1. Autism spectrum disorders can have associated ADHD, Seizure disorder and severe behavioural problems like aggression or anxiety. They may have sleep disorders, limited food preferences, stomach problems related to digestion, bloating and constipation. Some children may suffer depression or issues with self-image in adolescence. Keeping these few things in mind and referring for a psychiatric, paediatric or dietician opinion is worthwhile. Medications like risperidone for behavior problems, methylphenidate or atomoxetine for hyperactivity, aripiprazole for psychological disorders, melatonin for sleep disorders can be started to help symptomatically.

- 2. Attention deficit and hyperactivity disorders may need medical management if hyperactivity is uncontrolled and the attention deficit is severe to cause poor scholastic performance. Medications like amphetamines, methylphenidate, atomoxetine are commonly used.
- 3. Intellectual Disability may to lead to concerns in managing personal hygiene, hygiene during menstruation, dental caries, lack of nutrition etc. these children may be prone to sexual abuse and injury otherwise. Any suspicion of violence or injury should be referred and treated. Adolescent care can be explained to parents.
- 4. Downs Syndrome is a genetic disorder with typical features. They have intellectual deficiency and may have associated conditions like heart defects, hearing loss, poor vision, cataracts, constipation, hip dislocation, hypothyroidism, obesityand risk of leukemia. They may be considered for checkup at least once a year by a doctor.
- 5. Learning Disability can be considered in any child with poor school performance and complaints from teachers. Any associated behavioural issues can be treated with medications. They may have ADHD or seizures.
- 6. Global developmental delay is described as a delay in achieving milestones in at least 3 areas, regular neurodevelopmental assessment and treating any vision or hearing problems as early as possible can benefit the patient. Adequate calcium and vitamin supplementation with good nutrition is beneficial to the growing brain.
- 7. Cerebral palsy being injury to a growing brain affecting muscle contraction and tone, child can have spasticity and dystonia which can be alleviated with muscle relaxants like baclofen. Pacitane can be started for dystonia. Children often have accompanying seizures which require anticonvulsant treatment like valparin, leveracitam, phenobarbitone or phenytoin. Miadazolam nasal spray can be used in emergency to control seizures. Joint dislocations especially of the hip joint are known in these children, contractures and bone health need orthopaedic intervention as well. Any hearing loss can be corrected by hearing aids and vision loss can be referred for ophthalmological evaluation.
- 8. Neuromuscular disorders like muscular dystrophy are also treated with cardiac medications to decrease the effort of the heart muscle. Enalapril and aldactone are used for the same. Other neuromuscular disorders like spina bifida, Transverse myelitis can have low muscle tone and loss of bladder and bowel control. The chronic lack of movement in lower limbs can lead to atrophy or even deep vein thrombosis if not given good physiotherapy. SMA also presents as hypotonia, weight gain and inability to move. Bed ridden patients need good physiotherapy, chest physiotherapy, positioning, healthy diet for weight control and care of bed sores if any.

9. Other neurological disorders due to head injury or trauma can have a variable extent of damage which may require individual assessment, medications to improve tone and control seizures, physiotherapy and care of bed ridden patients. Many metabolic disorders can present with brain damage. Adequate nutrition and supplementation in patients with swallowing difficulties is a challenge requiring help from doctors even surgeons for peg tube insertion. Antioxidants slow the damage to nerve cells due to toxic metabolites. Calcium and vitamin D supplements improve bone health.

As a part of the team, the special educators can be more aware of the problems these patients go through, the medications they may need and any referral for better management.

The overall health through nutrition, adequate hydration, supplementation and prevention from any other disease through vaccination can improve their quality of life.

To conclude "The eyes cannot see what the mind does not know", hoping this knowledge will impart sight and add value to our patients' lives!

Special Education

"Teaching in a way that children can learn"

Special education is a vital part of the multidisciplinary treatment approach for children with neurological disorders. Special educators provide a range of services depending on the specific needs of the child.

Role of special educators:

Assessment and Planning

Children with special needs are assessed to determine their specific strengths and weaknesses. This assessment determines their specific needs and will help in designing the intervention which will further lead to achievement of a higher level of personal self-sufficiency

• Designing Individualized Education Program (IEP)

Special educators provide Individualized Education Program (IEP) to every child. The IEP addresses every child's unique learning issues and includes specific educational goals. For children with age of less than 3 yrs, an Individual Family Service Plan (IFSP) is made based on the child's present level of development in all areas. These services will help the affected children and their families achieve the outcome efficiently.

Each child must have an individualized Education Program (IEP) that distinguishes particular needs. These services will allow children to reach goals which will be assessed at the end of each term along with short-term goals that will be assessed every few months.

Guidelines for formulating an IEP:

- State the current level of educational performance of the child based on class tests and assignments.
- Setting of appropriate and reasonable goals that can be accomplished in a year and are measurable.
- The IEP should enlist the setting, specific special education including specific instructions and the professionals (related services such as physical therapy, occupational therapy, speech therapy and counsellor, transportation) whose services are required.
- The date of initiating the program and the duration of the program must be stated.
- For individuals above 16 years or older, the IEP must include the activities that will help prepare the student to leave school.
- Modifications and Accommodations

Based on the individual needs, modifications and accommodations can be made in the school curriculum, teaching procedures, assistive aides or equipment can be provided along with specialized physical adaptations which will make the child's participation in the educational program easy and convenient. Their learning space can be modified according to their needs and made free of distractions.

Interventions for Children with neurological disorders

• Training and Education of Autistic and Related Communication Handicapped Children (TEACCH)

TEACCH is a special education program using Structured Teaching, a process designed to capitalize on the relative strength and preference for processing information visually in individuals with autism, while taking into account the recognized difficulties. Individualized assessment and planning is used to create a highly-structured environment (organized with visual supports) to help the individual map out activities and work independently. Some of the other special education interventions used for students with disorders like Autism spectrum disorder:

- Picture Exchange Communication System (PECS):
- Floortime, or Difference Relationship Model (DIR):
- Discrete Trial Teaching (DTT) or the Lovaas Model:
- Pivotal Response Treatment (PRT)

Special education is extremely important for children with special needs so as to make education available to them. These children are lifelong dependent on their care takers for all activities of daily living. Special education along with other rehabilitation techniques will provide them with necessary assistance to live a fulfilled and an independent life. It helps in finding the interests and skills of the child and encouraging them to excel in it. This can boost their confidence. Children are taught social skills and are made aware of their surroundings. It facilitates an independent life for the neurologically disabled children and also improves their quality of life by providing knowledge.





Psychological Intervention

"Train the mind to train the body"

Raising individuals with disabilities can be a challenging process for the caregivers. Psychologists plays an important role in helping children with different disabilities manage their anxiety levels, modify their behavior, help them manage their anger and also help the patients as well as their families cope with their stress and other psychological issues. However, providing complete information and proper knowledge along with techniques to manage the complications makes it possible to manage these issues. Psychological treatment plays a pivotal role and involves the following techniques:

1. Behavior Modification: This involves focusing on one area at a time rather than dealing with all at once. Narrowing down a behavior will help us understand the function of the occurrence of a behavior so that it becomes easier to change and manage it. Behavior modification replaces undesirable behavior to more desirable ones through the process of Positive and Negative Reinforcement. Various strategies involved in behavioral Modification are : Positive Reinforcement: It is a process of increasing a desirable behavior by presenting a stimulus to the person after the desirable behavior is exhibited making that behavior more likely to occur in future. E.g. providing edibles, desired items like toys, stars, stickers, providing tokens and even verbal praises.



- Negative Reinforcement: It is a process of termination, reduction of a stimulus on the occurrence of a response which leads to an increase in the future occurrence of a response. E.g. Teaching cleaning up the mess to a child to avoid solving mathematical problems which s/he doesn't like. In the future, the child will be more likely to engage in clean up tasks because it was rewarded by removing aversive task of solving mathematical problems.
- Positive Punishment: Refers to presenting a stimulus immediately following a response which decreases the future frequency of that type of behavior in similar conditions. For e.g., Saying a "No" upon occurrence of aggressive behavior. Another example could be that a child is asked to clean up the toys after s/he throws it in the room.
- Negative Punishment: It involves removing a desired stimulus after an undesirable behavior is exhibited which also refers to withdrawal or loss of opportunity to earn reinforcement. For E.g., A child is asked to sit alone in the room after engaging in aggressive behavior with other children. As a result, losing the opportunity to be with others.
- Extinction: This procedure occurs when reinforcement of a previously reinforced behavior is discontinued. Hence, the frequency of that behavior decreases in the future. For e.g., Ignoring the child's behavior of throwing tantrums to gain teacher's attention. Here, attention was a reinforcement for the child which was put on extinction.
- 1. **Psychoeducation :** Refers to the process of providing information and educating patients and their family membersregarding a better understanding of their illness. Helping them develop a thorough understanding of the difficulties and challenges they face as well as provide knowledge of personal coping abilities. Psychologists also provide insight into



their own areas of strengths, and help them have a greater internal capacity in order to work towards mental and emotional well- being. Psychoeducation can be provided one-to-one as well as in a group. Psychoeducation has a positive impact on the child's and the caretakers' quality of lives. It changes the perspective towards the disorder and makes the treatment easier. Family Involvement in Psychoeducation increases compliance and confidence of the individual and ensures that the person is given adequate support.

Psychoeducation can be provided in the following set up:

- Private Clinics
- Hospitals
- Special Schools
- Through Internet
- Rehabilitation Centers
- **3. Family Counseling**: Presence of a family member with an illness involves attention in the form of time and resources. Psychologists conduct family counseling to help the family members vent out their emotions, help them cope with situations better and provide a nurturing environment to the patient.

Family Counseling can help with different issues like :

- Parents' mental health
- > Trauma due to family member's illness
- > Issues like stress, anxiety, depression and grief
- Stress due to financial problems
- Relationship between the parents

Psychologist practicing family counseling uses different approaches:

- Family Counseling using Cognitive Behavioral Therapy : It attempts to change the ways people think or behave in order to reduce the problem.
- Family Counseling using Psychodynamic techniques : It tends to look more into the individual's own subconscious minds. It is based on the principle that providing the individuals in the family the real reason behind what is going on, and this will help the people to deal with their difficulties more easily.
- Systematic Family Counseling: It attempts to identify different kinds of problems, relationships, ideas, attitudes and thinking of the whole family. Once these areas are discussed with the family members, the counsellor attempts to shift the problems, attitudes, relationships, to a position that is more beneficial, less damaging, or simply make it more realistic.

Systematic desensitization: Solving difficulties step by step systematically help any individual to get cure and achieving goal

There are various techniques and intervention method which help individuals with and without disabilities to overcome from the current phase of pain. Most important task is to make sure that whether we are able to provide conscious level of mind to seeker, if it is developing and visible and measurable, it means an individual healing by himself or herself.

Think about Thinking!

Applied Behavior Analysis

"Behaviors can be changed"

Applied Behavior Analysis (ABA) is a scientific study of behavior. It is defined as the process of systematically applying different interventions based upon the principles of learning theory. ABA therapy improves socially significant behaviors to a meaningful degree. It involves various techniques to increase and decrease a target behavior.

ABC MODEL

It refers to Antecedent, Behavior and Consequence. These are the building blocks of analyzing and changing challenging behaviors.

Antecedent- These are events or behavior which precedes the target behavior. It happens right before the behavior has occurred. It might be a request/ command given by the teacher/ therapist, it also refers to any situational event, e.g. presence of another person.

Behavior- This refers to the 'Target Behavior'. Everything a person does, says, feels or thinks is a behavior. Any reaction or response from a person is a behavior. In order to increase or decrease the target behavior, it is important to clearly define the behavior.

Consequence- This refers to what happens after the behavior occurs. It could be a reaction from a therapist/ teacher/ parent in the form of a tangible reward, verbal praise, or a reprimand.

Example of an ABC Model

Antecedent: Therapist provides instructions to a child to fix a two piece puzzle

Behavior: Child fixes the puzzle

Consequence: Child receives his/her favorite toy as a reward from the teacher

Different Strategies of Applied Behavior Analysis

1. Discrete Trial Training

Discrete Trial Teaching (DTT) is a method of teaching skills to a child which involves breaking down a skill to be learnt into small discrete steps and repeated trials are taught one-to-one. For e.g. Therapist teaching colors to a child might start by teaching red color. She would ask the child to point to red and then reward the behavior if the child responds by pointing to the red card. She would then move on to teaching blue, reinforce the skills and ask about both the colors together. DTT have found to be effective in teaching skills to children with Autism.

2. Shaping

The process of shaping involves differentially reinforcing any successive approximations towards a terminal behavior. Differential Reinforcement is a procedure wherein reinforcement is provided for responses that share a predetermined criterion and reinforcement is withheld for responses that do not match the criterion. Eg: Teaching a child how to wear his eyeglasses by himself involves the following steps:

- Teaching the child to first pick up the glasses by himself and reward is provided immediately
- Once the child learns to pick up the glasses, reward is then provided if the child learns to place the glasses up to his face
- Once first two skills are mastered then the therapist moves onto the final skill i.e. placing the glasses in their proper position and reward is provided for performing the final skills and not the first two skills.

Shaping uses a positive approach to teach new skills. Shaping can also be combined with other established behavior change or behavior building procedures such as the chaining.

- **3. Chaining:** A behavior chain involves breaking down skills into simple steps or units. Every step performed by a child is reinforced in a behavior chain. E.g. : Teaching a child to wear his jacket by himself would involve the following steps in a behavior chain.
 - > Obtain the jacket from the closet
 - Place one arm in sleeve
 - Place second arm in sleeve
 - > Zip up the coat
- **4. Prompting:** Prompts are supplementary antecedent stimuli that are used to occasion a correct response which eventually controls the behavior. It is a physical help, instructions, gestured and demonstrations provided by the therapist to teach a child and eventually increase the responses from the child.

Types of Prompts:

- **Physical Prompts:** It is also known as hand over hand prompt. It refers to physically guiding the child to complete a task. E.g., holding a child's hand to teach body parts.
- Verbal Prompts: It involves any verbal assistance or a hint that is provided to teach any skill to the child. E.g. "asking the child what is the color of the sky?" and providing prompt like "say Blue.".
- **Gestural Prompts:** It involves pointing, touching an object or any other action a child can observe in order to learn. E.g., pointing towards a cup and asking the child "what is something you drink from".
- **Positional Prompts:** Involves using 2D cards or objects on the table. To implement a positional prompt, a therapist, while

teaching object identification to a child between 'Apple' and 'Banana', will place apple card close to the child.





- **Visual Prompt**: It is also known as Model prompt where the child learns by observing others or looking at videos, flashcards etc. E.g. Teaching a child turn taking by showing videos of kids engaging in turn taking.
- Auditory Prompt: It involves any kind of sound a child can hear in order to complete a task. E.g., Mother tells the child "clean up your toys" and prompts the child by setting up a timer to go off in 2 mins as a cue for finishing the clean up task.

However, it is important to fade away these prompts to avoid prompt dependence. For E.g., In order to teach a child how to Zip his jacket, therapist will provide prompts hierarchy in the form of Hand-to- hand, hand to elbow, hand to shoulder and then no physical contact.

- **5. Imitation Training:** Imitation training is an important aspect in the development of a child. Imitation skill teaches various other skills to the child such as pretend play, social play, language other skills that requires observational learning. Steps to teach imitation skills :
 - > Sit with the child face to face
 - > Make sure the child is giving eye contact
 - Give the instruction to the child as "do this" and show the model for imitation
 - Wait for 3-5 seconds if the child imitates give reward if not then physically prompt the child
- 6. Self-management Training: Self-management training is a useful technique to achieve greater levels of Independence and generalization among people with Disabilities. Self-management involves the following components :
 - Self-Monitoring- It is a procedure whereby a person observes and responds to, usually by recording, the behavior s/he is trying to change.
 - Self-evaluation- It involves comparing performance of oneself with a predetermined goal or standard.
 - Self-monitoring with Reinforcement-This involves providing reinforcement to oneself for either meeting goals selected for oneself or taught by others. The reinforcer can be self-administered or delivered by a therapist.

Applied Behavior Analysis investigates socially significant behavior with immediate importance to the children. It also entails precise measurement of the actual behavior in need of improvement. It is effective and improves behavior sufficiently to produce practical results for the child. Lastly, it produces behavior changes that last over time, appear in other environments and generalize the appropriate learned behavior.

Physiotherapy In Neurological Disorders

"Physical movement as a medicine for brain functioning"

The term 'neurological disorder' applies to conditions that arise from dysfunction in part of the brain, spinal cord and/or peripheral nerves. This can result in difficulties with movement, muscle tone, strength, sensation, balance etc. resulting in a condition that impact the ability of a child to perform certain tasks like other healthy children. Children with special needs are at risk of being uninvolved in decision making, unable to access further education, are underemployed or unemployed and generally unable to lead fulfilling lives. Physiotherapy is a professional health discipline which is directed toward prevention and alleviation of movement dysfunction to promote maximal independence in children so affected, thus helping them to function effectively in society.

The role of physiotherapy in neurological disorders is to provide a detailed assessment and treatment to ensure that the child functions to the maximum possible level. Physiotherapy helps a child gain confidence and enhances his/her self-esteem through promotion of independence.

- The Physiotherapist's assessment has 2 initial purposes:
 - To help identify children with disabilities requiring physiotherapy and related services;
 - To document impairments, their degree of severity and provide baseline information that help in developing intervention goals and objectives.

Physiotherapists provide services to children with disabilities in 4 main areas:

Improving motor function:

i. Maintaining/improving Range of Motion (ROM)

After examining, the current problems are identified. ROM exercises that incorporate stretching and exercises to lengthen the tight muscles and prevent deformities, and reduce contractures are prescribed.

ii. Enhancing motor experiences

This may be achieved through an individualized exercise program through Integration of tactile, visual, auditory, proprioceptive, kinesthetic and vestibular input.

- Examination and evaluation allows for the planning of intervention strategies that target specific impairments.
- The goal is to have an effective carryover from the treatment sessions into real life.
- The therapist's knowledge of how typical development occurs helps the therapist prevent undesirable postural changes.
- Firm balls and bolsters are often used as they provide for mobile surfaces that can aid the therapist in facilitating postural control and functional movements in the child.







- Improving balance which helps in developing neck and trunk control and enables controlled task performance.
- This is usually achieved through strengthening of core muscles or central muscles, mainly the trunk muscles, through use of balance boards, one leg balance on a bench, performance of reach outs, etc.
- Promoting mobility and independence through training of gait, transfer skills. Benches of various heights are often used for training sit to stand and vice versa transitions, stepping, climbing stairs and so on.
- Training motor skills which help organize attention and behavior. Current studies suggest that aerobic activity performed 3-5 times a week improve cognitive, mental and social functioning.
- Increasing strength, coordination and speed in manipulative or fine motor skills. Improving hand eye coordination which is the ability to receive and process information received from the eyes to guide and direct the hands such as in writing and catching a ball.
- > Increase cardiopulmonary endurance and tolerance.
- Evaluation and recommendation of assistive devices and/or adaptation :
 - Children with physical disabilities may require adaptations and/or devices, splints, braces, etc. to facilitate functional independence.
 - Adaptation involves adjustments or modifications in the environment, while assistive devices are those objects that are used to increase the functional abilities of a child. Physiotherapists along with occupational therapists can evaluate and recommend the appropriate assistive devices and adaptations necessary for the optimum functioning of the children.
 - These are also useful in providing appropriate body alignment and stability and to correct contractures and prevent deformities.

• Positioning and facilitating movement:

- Correcting posture and positioning, and advising appropriate seating posture.
- Proper positioning is essential to establish the postures and movements necessary for function in a meaningful way and training normal patterns of



movement and improving the ability to perform daily activities. For example, supporting the child's knees and feet to keep them apart and in the normal anatomical position, to develop weight shifting, rotation, coordination and balance in sitting.

- The therapist provides a variety of position options for children that prevent joint movement limitation and skin breakdown, promote postural stability, and train children for performing transfers.
- Particular positioning, moving and handling techniques are specified for a child so that is used by each person involved with care of the child.
- > Educating parents/teachers to ensure safety of a child:
 - Providing advice regarding use of wheelchair, adaptive equipment, home exercise program that ensure safety of children during transitions.
 - Provide instructions to caregivers, teachers, parents, etc. for minimizing contractures and deformities, maintaining skin integrity, wheelchair mobility, ensuring safe movement between and in different environments.
- Therapists use different techniques depending on the child's disabilities.
 - 1. <u>NDT (neurodevelopment therapy)</u>: it is a therapeutic approach, which helps in assessment and management of movement problems or dysfunction in children with neurological dysfunction. It aims to maximize child's functional capabilities. It is also known as Bobath therapy and was developed in 1940's by Dr and Mrs. Bobath. The treatment aims to make desired movements more possible and prevent undesired movement. It also helps to achieve normal motor milestones in children with cerebral palsy. It is widely used therapeutic approach and gives the best functional output.
 - 2. <u>Patterning:</u> it is a concept based on the theory that typical brain development can be facilitated in the brain injured child by passively repeating the sequential steps of typical development. Failure to normally complete one stage of development impairs the development of subsequent stage. This approach is laborious and also requires multiple sessions every day. Parents and caregivers are trained to carry the procedure at home also.

- 3. <u>Constraint-induced therapy</u>: this therapy aims to improve the use of affected hand in child with hemiplegia (paralysis of one side of the body). The normal hand is plastered for couple of days, to improve the use of affected hand.
- 4. <u>Hippotherapy</u>: it's a technique of horseback riding which has shown improvements in muscle tone, posture and balance.
- 5. <u>Pediasuit</u>: this techniques involves a number of different elastic cords to specific points on one end of patient's body to different points on the other. This device helps to move the patient move independently while controlling their movement as well as strengthening different parts of the body.

Occupational Therapy for Children with Neurological Disorders

"Therapies to make activities meaningful"

Occupational therapy is the only profession that helps people across the lifespan to do the things they want and need to do through the therapeutic use of daily activities (occupations). Occupational therapy practitioners enable people of all ages to live life to its fullest by helping them promote health, and prevent—or live better with—injury, illness, or disability. It facilitates engagement of the child in meaningful activities of daily life (such as self-care skills, education, work, or social interaction)

Goal of an occupational therapist is to help children with affected physical, cognitive and social functions, to participate successfully in school and social environment.

<u>Problems faced by children with neurological disorders in their day to day living:</u>

• Physical limitations like restricted joint movements, contractures, weakness of hand and leg muscles, increased tone (Spasticity), Decreased tone (Hypo tonicity), Tremors and in-coordination can lead to difficulty in holding the

pen / pencil, Difficulty in writing, difficulty in turning pages ,lifting books, objects, difficulty in participating into play or sports activities affecting the academic life of the child.

- Affected cognitive functions can lead to problems like difficulties in reading, writing, calculating, remembering things, etc.
- Affected social skills can cause problems like, inability to maintain eye contact, difficulty in having conversations with others, difficulty in participating into group activities, difficulty in playing team games, difficulty in participating into annual get together.
- Children who have sensory processing issues and showing autistic features show behaviors like hyperactivity, poor attention, inability to sit at one place, easy distractibility, showing behaviors like rocking, jumping around, stereotypical movements of the hands, distractibility because of light and noise.
- All these problems result in increased difficulties in doing basic daily living activities like eating , brushing, self care, dressing, bathing, toileting.

Occupational Therapy Interventions for improving performance :

Splints:

- Splint is material or a device used to prevent, protect, correct, position, and for improving the functions of the body part.
- Splints can play an essential role in improving Childs function and to make him independent.
- Eg. Child with hand muscle weakness can use a hand splint for doing functional activities like holding the pencil, drinking water.
- Use of corrective splint for foot for correcting calf muscle contracture.
- Using a small finger based splint for correcting finger contracture.

Adaptive devices:

- These devices enable the child to improve his abilities to perform activities of daily living
- E.g. Writing device for improving handwriting,
- Use of pencil grippers for children who have difficulties in holding the pen/pencil

- Use of modified papers (Highlighted paper, ruled paper) for children who have difficulties in writing
- Use of weighted cuffs, weighed pen, weighted glass for reducing tremors and incoordination for children with ataxia.
- Modified spoon for improving eating
- Use of modified shirts, buttons, for teaching dressing skills for children.

Assistive technology:

- Assistive technology is an 'umbrella term' that includes assistive, adaptive, and rehabilitative devices for people with disabilities.
- Assistive devices can be divided into three categories Low tech, Medium tech and High tech devices
- Assistive technology acts as a connecting bridge between what a child can do and what child needs to do.
- Low Tech Devices: Modified notebooks, Textbook magnifiers, Braille books, Picture boards
- **Mid Tech Devices:** Calculators, Videotaping, Assisted listening devices, Voice amplifier, Switch controlled devices, electronic wheelchairs.
- **High Tech Devices:** E reader, Word processor, Speech recognizer, use of touch screen tablets, Gait trainer, High technology wheelchairs, voice activated headphones.

Sensory Integration therapy:

Sensory Integrationis the ability of a person to receive different sensory inputs , process and understand them, and then respond to them in an appropriate way. Because of sensory processing disorder, children have problems in directing, regulating, interpreting, and responding to sensory input. Hence, Sensory Integration therapy may help in managing these issues. The intervention includes:



• Activities to work on tactile system: Sensory kit (Materials with different textures) Thera putty, play dough, shaving cream. Gel, Finger painting.

A Handbook on Neurological Disorders for Special Educators

- Activities to work on propreoceptive system: Deep pressure with therapy ball, Massage Vibrator, Jumping activities, Wheel barrow.
- Activities to work on vestibular system: Swings, scooter boards, slides, trampolines, Obstacle course.
- Regulating auditory and visual sensory environment helps children to focus on their tasks.



Classroom modifications:

- Modifying the classroom environment according to child's need is an essence to improve functional performance.
- Providing proper seating arrangements. (Seat cushions, arm rests, foot rest)
- Having an appropriate access for children on wheelchair.
- The school should have provision like ramps.
- Doorways should be broad enough for easy maneuvering of the wheelchair, Door thresholds should be removed.
- Toilet seat should be of same height of that wheelchair.
- There should be sufficient light in the classroom.
- Position of the child should be next to the teacher.
- Use of different colors for respective books
- Long assignments should be divided into short assignments
- Use of computers for children with physical, cognitive limitations.

Cognitive training:

- Use of visual, auditory, tactile cues for improving memory. Eg. Use of visual schedules, flashcards.
- Memory games for improving orientation with respect to time, place and person
- Breaking down the task into small subtasks and finding strategies to improve cognitive performance
- Use of mnemonics.
- Use of computer games for improving cognitive skills.

• Visual perceptual training:

- Identifying objects from the cluttered environment
- Finding a specific image from the group of images
- Improving directional concepts through games like dot joining, building blocks.
- Completing the pictures which are partially drawn
- Tracing the design
- Puzzle games for improving sequencing abilities.
- Working on maintaining spacing between two letters, two words and in between two lines.
- Working on child's ability to identify letters, words, shapes oriented in different ways.
- E.g. Practice building block designs according to a diagram or a model.

Social Skill Training:

- Activities to improve eye contact while doing the task
- Wishing / greeting others while meeting them
- Eg. By shaking hands, by saying good morning, good afternoon.
- Expressing your own opinion
- Team game activities and Group activities.
- Social play games, participating in drama
- Facilitating leadership skills by giving the child opportunity to direct the game.
- Activities like role playing, modeling help to develop social skills.

Occupational therapy plays a vital role in managing children with physical, cognitive, social problems. They identify the problems faced by these children at early stage and formulate personalized therapy intervention based on the disabilities which is the essence of making children more independent in their functional skills. It helps in improving the quality of life of these children to a great extent.

Speech and Language Therapy

"Speech: an exclusive gift to humans"

Children with Neurodevelopmental disorders suffer from various types of communication disorders which includes deficits in language as well as speech.

- Language disorders: Difficulty in the acquisition and use of language.
- Speech sound disorders: lack of phonological awareness of sounds.
- Fluency disorders: Disturbance in normal fluency.
- Pragmatic communication disorders: severe deficits in social communication and interaction.

A common long-term goal for speech language therapy in children with Neurodevelopmental disorders is to establish effective communication skills.

Depending on the speech-language characteristics the short-term goals of speech therapy could be as follows:

1. If the child has Motor speech disorder (mainly Dysarthria) due to impairments in coordination of phonation, respiration, resonance and articulation the following techniques can be used.

- Oro motor and Proprioreceptive Neuromuscular facilitation (PNF) exercises of the oral cavity can be used to improve oral-facial muscle tone and coordination of articulators for improving speech intelligibility/ clarity as well as improving oral sensory awareness, reduce drooling and solve the problem of tongue thrust
- This can be achieved through various exercises
- Oromotor exercises include, massaging the cheek muscles and muscles around the lips with the help of fingers. Whereas, **PNF exercises** include massaging the inner oral cavity which include the inner cheek muscles and tongue with a finger brush/vibrator brush (Z vibe) and also improve oral sensory awareness.



- **Blowing Exercises** Blowing candles, paper bits, bubbles and whistle to train the facial muscles to produce certain sounds and to improve residual lung volume capacity/ breath support and breath control.
- **Breathing Exercises** Facilitate abdominal breathing by doing inhalation and exhalation exercise to strengthen the diaphragmatic muscles and improve breath support for speaking longer phrases.
- Jaw Exercises Use of chewy tubes {knob shaped, P and Q (XT)} to improve jaw mobilization and eating foods that require extra chewing, like apples and carrots, to strengthen jaw muscles; practicing opening and shutting their mouth using only the jaw muscles while someone else holds their chin.
- Lip Exercises Using a lollipop, squeezing their lips around it to increase strength and lip closure, pursing their lips to kiss a lollipop to improve lip extension.
- **Tongue Exercises** Strengthening the tongue by sticking it out and pushing it against a tongue depressor/ ice cream stick/ spoon for seconds at a time.

2. Articulation/speech sound disorders:

• To improve articulation skills of the child through Articulation Therapy,a

mirror and phonetic placement technique is used i.e. use of flash cards and word lists to help focus on specific sounds and encouraging children to make sounds while looking in the mirror to help them understand how to place their tongue at specific positions in the oral cavity to produce specific sounds.



3. Language disorder:

If the child is suffering from language or

communication disorder, then the following could be the short term goals of language therapy.

- To improve receptive and expressive language skills:
 - In younger children, the main thing to be done is to provide them with intensive language stimulation during their early years. This will help the child to improve their receptive vocabulary and encourage use of verbal mode for communication.
 - Language and Word Association using flashcards/ puzzle pieces of word pairs e.g. toothbrush- toothpaste, comb-hair, shoes-socks, etc and putting together puzzle pieces.
- To improve receptive vocabulary/identification of the following categories:
 - > Common objects (Items of food, clothing, furniture, kitchen objects)
 - > Lexical categories (fruits, animals, vegetables and vehicles)
 - Verbs (sitting, eating, drinking, etc)
 - > Adjectives (clean, dirty, big, small, tall, etc)
 - Prepositions (up, down, beside, front, between, etc)
 - > Adverbs (fast, slow, etc) and all other grammatical forms.

This can be done using flashcards. Expose the child to the pictures holding at your eye level and then keep 2 pictures in front of the child and ask him to pick up one picture from set of two pictures.

• To improve expressive language skills of the child:

- Use of vocal play sounds i.e. animal sounds (dog says "bow bow", etc) and vehicle sounds (car horn: peep -peep, etc) to encourage the child to speak and use verbal mode to communicate.
- Improve verbal speech imitation skills of the child i.e. ability to repeat sounds/ words after you.
- Encourage the child to speak names of family members: Prepare a small family album (1 picture on each page) and encourage the child to imitate the names of family members after you.
- All the above grammatical forms mentioned in the receptive language vocabulary needs to be taught to the child to name it verbally using flashcards or picture books/ albums. Show the picture to the child and ask him to "name the item/ object in the picture". First allow the child to imitate after you later on you can ask the child to say it on his own.
- Once the child learns to repeat and spontaneously say 1 word to express himself then gradually the "Mean length of utterance (MLU)" can be increased to 2 word phrases up to 4 to 5 word phrases and complex sentences.
- Higher language abilities i.e. picture description skills, story retelling, story generation and conversational speech can be improved using more of visual learning through picture description charts, short story sequence cards, etc.

4. Non-verbal communication:

Non-verbal children are often taught sign language, or are taught gesturing, to communicate with others. But, advancements in technology and some old stand-bys have proven especially effective in allowing children to compensate for gaps in their abilities.

Manual tools which can be used include:

- Erasable boards
- Picture board or books a child can point to
- Word cards to express thoughts
- Flip charts to relay more complex messages

Assistive technologies include:

- Alternative communication systems which use symbols for communication
- Computers used to type simple messages
- Computers that are pre-programmed with messages
- Vocal synthesizers
- Software that allows a child to push a lever or point to pictures or words, sometimes with a joystick or an infrared point.

A speech and language therapist plays an important role in the developmental of children with neurological disorders. They make it possible for these children to communicate their needs appropriately. They also help in improving their breathing and swallowing which manages the associated complications.

Art Based Therapy

"Art of expressions"

Art is therapeutic in nature and connects with one's cognitive and subconscious mind and hence aids in healing. Art Based Therapy or ABT is a non-verbal form of therapy which helps children with neurological disorders to express and communicate through art. These children have difficulty in communication. So, art becomes a medium of communication for them. Children express their feelings like fear, happiness, sorrow and anger through colors and art. It does not only include drawing and painting but also includes different forms of art such as music, dance, drama, etc. Depending on the skills of a child, capabilities and needs the therapy can be modified accordingly.





Module of ABT

ABT is based on the understanding that each person possesses intellect, body, emotions and subtle energy fields. Each of these dimensions is created in alignment with the individual's purpose in creation. 'There is a definite method or approach that we follow in ABT, but we do not restrict ourselves with the module. In fact, most of the time it is molded in a way to help heal the child rather than out a pressure of performance. The therapy encompasses five components - meditation, warm-up, actual activity, de-rolling and closure.

However, these components can overlap during the course of the therapy or a session. Here is how a session of ABT is like:

- 1. **Meditation**: The ABT therapy starts with meditation. Children with neurological disorders have behavioral issues along with affected attention and concentration. Hence, meditation can help calm these children before the therapy session. Meditation for special children includes music, like simple chants or rhythmic recitation of ohm. Music has a healing effect on their mind and it helps calm the mind and get into a receptive mode to carry on with the therapy.
- 2. **Warm-up:** Next, we move on to a warm up session which includes some physical activity like exercises to establish a mind-body connection. For instance, if the therapist wants to make the child draw a triangle or a circle on paper then they will help him/her do the same activity in the air using their hands. Or make them jump on three corners of the room trying to explain the concept of a triangle
- 3. Actual activity: 'The next thing would be to get down to the real activity, that is, to draw a triangle on a paper and paint it with the thumb. There can be one or many triangles drawn. The colors will help relax their nerves and let them communicate with the world in their own way. Depending on their mood they choose the colors.
- 4. **De-rolling**: After a while it's time for de-rolling or unwinding, which is again a methodical approach to revise the entire activity of the session.
- 5. **Closure**: 'The last phase of the therapy aims at teaching the child some basic mannerisms like relationship integration, saying thank you or bye to the therapist, because for a special child you cannot take these things for granted, and have to ingrain it in them through the therapy. However if the child still remains hyperactive while reaching the end of the session we resort to music

again to calm the nerves and help him/her move out of the hyperactive mode. Sometimes helping a child go to sleep with music on during the closure phase also helps.

Is the approach same for every child?

Above Five phases would remain same for every special child undergoing the therapy but their needs might differ. 'If say, a child has compromised verbal skills, then the approach would slightly differ. The actual exercise might have a lot of verbal stimulation. For instance, telling a story of a crow, sparrow, dog or a cat. The therapist might need to enact like the said animal and make the noises

while encouraging the child to do the same. This kind of exercise also helps calm a hyperactive child.

No matter how the session has to be changed or molded to meet the need of the child every session has a stipulated time for drawing and painting, voice exercise, physical movements, storytelling and drama.

How does it help in learning and development?

Art gives the child the freedom to explore and express themselves without any boundaries of verbal expression. No formal training in any art form is required for a person to experience a session. What is created at the end of an ABT session is not important but the process of getting in touch with your inner self through the art forms is what is important.

Benefits of Art based therapy:

- Art based therapy helps children develop social skills, it reduces behavioural issues, stress and increases self-confidence.
- It helps children with affected communication skills express their feelings and emotions through different drawing and painting. Thereby increasing their communication skills.
- It also helps them explore their imagination and creativity and think symbolically
- ABT develops their ability to recognize and respond to facial expression and interpreting tone of voice. It develops properties likeco-operating with other children, turn taking, teamwork, sense of acceptance and other social skills.
- It reduces stress & anxiety and help these children relax.

Art Therapy is an active & physical, fun, and stimulating procedure which enhances the communication skills in children with neurological disorders. It has shown to modify the brain's physiology and structure and lead to a more flexible, adaptable individual.

Hand Therapy

"Creativity begins in the head and culminates with hands"

Hand is the functional unit of the body used for creativity, work and leisure activities. In children with some neurological disorders such as cerebral palsy, GDD, Neuromuscular disorders, ataxia, etc, hand functions are affected due to contractures, muscle tightness, deformity and muscle weakness. Thereby, hampering their ability to perform basic activities such as playing, writing, holding objects, eating, bathing, transfers, etc.

For a hand therapist, it is important to identify the limitations in hand functions, improve them through intervention and help them perform the tasks independently. They must make sure that the activity is appropriate for child's cognition and it should be a meaningful and purposeful activity.

Activities to improve Hand Functions:

1. Grip and Grasp

- Clay activities
- Pulling the tube
- Squeezing the ball
- Squeezing the water from the sponge dipped in the water.



- Hand gripper exercises
- Finger aerobics
- Cutting paper with scissors

2. Pinch

- Clay games
- Cloth clip activities
- Folding papers, folding clothes
- Tightening and Removing screw by using screw driver

3. Opposition

- Squeezing the jelly balls by keeping them in between finger and thumb
- Flipping of Playing cards
- Paper tearing activity
- Putting stickers on the page and removing them
- Peg board games (small pegs)
- Putting coins in the piggy bank by using different fingers along with thumb.

4. Release

- Ball flicking
- Carom board activity
- Spider web activity
- Putting the rubber band in the fingers and extending them

5. Fine motor co ordination

- Bead stringing
- Picking up small objects like pins from the table top
- Making paper balls by crumbling small pieces of paper
- Picking up small objects by using the tweezers
- Spinning tops
- ADL activities like buttoning, zipping

6. Bilateral Hand Co ordination

- Picking up pegs together by using both hands
- Throwing balls in the basket by using both hands (alternately or together)
- Turning the blocks simultaneously
- Flicking coins by using both hands
- Stacking blocks









7. In hand manipulation

- Turning the coin within the hand
- Flipping the coin
- Removing the cap of the pen by single hand
- Handling objects with different shapes and sizes
- Turning the glass filled with water with fingertips without spilling of water
- Hold the pencil in the hand and turn it in between your thumb and fingertips
- Sharpening the pencil by using hand held sharpener

8. Handwriting

- For writing on the paper, child should have good visual perceptual skills,
- Steps for teaching handwriting skills are as follows
- Working on the directional concept.
- Working on maintaining space in between letter, words and two lines.
- Working on strokes (vertical, horizontal, slanting, curves)

9. Hand Functions and daily living activities

- Squeezing the tooth paste
- Removing and Putting the bottle caps
- Buttoning
- Zipping
- Putting hooks while wearing clothes
- Fastening the waist belt
- Wearing the wrist watch, necklace.
- Kitchen work like peeling the vegetables, cutting vegetables.
- Closing the buckles of the school bags.
- Fastening the shoe belts, Tying the shoe laces.

Aquatic therapy for Neurological Disorders

"Forgetting disabilities in water"

Aquatic therapy is making use of water and specifically designed activity by qualified personnel to aid in the improvement and maintenance of the quality of function for people that haveshort term or long term disabilities, syndromes or diseases.

One would wonder how can exercising in water help us when we eventually must live on land. Exercising in water helps us because water provides us an alternative environment where the body is more supported and can experience a greater freedom otherwise unavailable on land. Aquatic and land based rehab should be done simultaneously to achieve maximum results. Aquatic environment may seem unsafe due to risk of drowning and therefore a session must always be done under supervision of a trained and qualified professional.

Aquatic therapy may consist of individual sessions with therapist and the child, it may also consist of sessions where the family members or care takers are involved or the sessions may also be conducted as group therapy with multiple children and their parents or care takers.
Various techniques are used in aquatic therapy. Some of the most commonly used techniques are Halliwick, Bad Ragaz ring method, Watsu, Aai Chi and aquatic exercises.

Why aquatic therapy?

There are several beneficial effects of water immersion. These physiological effects can help reduce the symptoms of many of the adult and pediatric neurological disorders. The physiological benefits of water immersion are combined with targeted and focused goal oriented therapeutic activities in aquatic therapy. Although immersion in water has these beneficial effects these could be amplified if used as therapeutically. A therapist while planning the aquatic therapy session takes into consideration limitations of the patient and makes use of his or her strengths to provide alleviation of the symptoms.



Beneficial effects of water immersion:

Heart and lungs

Water exerts compressive pressure on the blood vessels and pumps up the blood from limbs to the heart. In children with cerebral palsy because of inactivity or muscle weakness or low muscles tone the blood circulation may be sluggish. This causes the blood to be pooled in the lower extremities and toxic waste to be accumulated. Immersion in water helps clear the toxic wastes. Improved blood pumping in the heart also provides heart with more blood to pump out improving the blood supply to the lungs and better oxygenation of the blood.

Compressive forces of the water provide resistance to the respiratory muscles (muscles required for breathing) and help strengthening these muscles. Exhalation or breathing out is passive rebound compression of the rib cage, as

the tone of the muscles alters this relaxation is difficult. Incomplete relaxation leads to exhalation of the air from only the upper parts of the lungs and accumulation of air in lower parts. Such accumulation could have various detrimental effects on the body. Immersion in water compresses the rib cage helping in better exhalation and lesser accumulation.

Muscles and bone

Immersion in the water increases the blood returning to the heart and in turn the blood delivered to all the organs. Most of this blood is supplied to skin and muscle tissue. Blood supply to the deep muscles increases nearly threefold during chest level immersion. Immersion offloads the joints facilitating relaxation of the muscles and smooth movements. The resistance provided by viscosity of water for any kind of the movement helps in stabilizing the tone of the muscles. Joint compression combined with increased blood supply help in reducing the tone of the muscles. Viscosity of water helps in strengthening the muscles. Improved circulation helps improve flexibility and pliability of the muscles.

Brain and Nervous system

Increased blood supply to the brain leads to improvement in memory and other cognitive symptoms. The child is more attentive in the water. Water immersion facilitates stimulation of para-sympathetic nervous system which facilitates relaxation of the body and suppression of the sympathetic nervous system that is responsible for the responses of anxiety. Immersion in water therefore facilitates relaxation and further suppression of the nerve signals that are responsible for increased tone of the muscles.

These beneficial effects of water immersion are used by for therapeutic benefit by aquatic professionals. It is important to understand that although immersion in water is beneficial, goal oriented and targeted exercises are required for optimum recovery in cerebral palsy.

When combined with goal oriented therapeutic activity. Aquatic therapy provides several benefits to the patients.

Benefits of aquatic therapy in neurological conditions

- Sustained reduction in spasticity
- Improved muscle and movement co-ordination
- Improved oromotor control
- Improved respiratory capacity

- Better flexibility of the muscles
- Improved walking patterns
- Improved eye hand co-ordination
- Improved muscle strength
- Improved cardiovascular endurance
- Regularization of the sleep patterns
- Reduction in the abnormal involuntary movements
- Reduction in the sudden spasms of the muscles

• What to expect in an aquatic therapy session?

Aquatic therapy does not mean swimming. Aquatic therapy includes purposeful therapeutic movements or exercises performed in order to achievereduction in the symptoms. There are various techniques in aquatic therapy. An exercises session will consist of a combination of these techniques and approaches like Water specific therapy technique, Bad-Ragaz ring method Technique, Clinical Aai-Chi, Aquatic exercises, Aqua aerobics and Passive relaxation or Watsu. Mostly in cerebral palsy an exercise session will be conducted one – on – one by the therapist. Occasionaly, therapists may form groups of patients with similar impairments and limitations and conduct group session with parents or care givers.

In the beginning the exercise session will emphasize on adaptation to water environment and being comfortable in water. Therapist may choose to engage the patient in various play activities on the surface of the water. This will be followed by respiratory and oromotor control in water where the child will slowly be introduced to under water environment facilitating better breath control. Various play activities may be used to improve oromotor especially the breath control. Once the patient is comfortable in water and has achieved good breathing control, various rigorous goal oriented activities will be performed during subsequent exercise sessions.

What precautions to take during and after an exercises session

- Consume plenty of water during the exercise session
- Make sure to empty the bladder and bowel of the child before immersion to prevent accidents in water and soiling
- If the child needs to sit on the edge, to enter and exit the pool then carry a mat on which child can sit to avoid aberrations and wounds.
- Make sure that there is no open wound on the body

Is aquatic therapy an alternative to land based therapy?

No aquatic therapy is not an alternative but a conjunct to it. Land based rehabilitation and aquatic rehabilitation needs to be performed together. Neither is alternative to the other. Although there are some advantages of aquatic rehabilitation as compared to the land based rehabilitation both are essential for optimum recovery.

Therefore, aquatic therapy may be preferred in some patients. It provides an excellent medium to train the child and improve their motor impairments. It is fun and enjoyable ensuring long term adherence. It also helps to maintain various cardio-respiratory health parameters. It is relatively a new form of therapy in India, however it has been an established form of therapy worldwide for decades. It is safe and very effective in improving the quality of life of the children with cerebral palsy. However aquatic therapy alone is not sufficient and must incorporated in the multidisciplinary rehabilitation program.

Chapter 21

Animal Assisted Therapy

"Animals can be human's best friends"

Animal Assisted Therapy (AAT) is a type of therapy involving animals as a part of treatment. It plays a major role in improving social, cognitive and emotional functioning of the child. Animal –assisted therapy can vary from something as simple as bringing a pet home like a pet dog, cat or it can also be very structured as horse riding or swimming with dolphins. Children with affected social and emotional skills are not able to form social bonds. Animals act as intermediary objects, allowing children to first establish bonds with them and then extend these bonds to humans. A particular kind of bond and relationship formed with animals can help children with a better sense of well- being, confidence and develop sense of empathy. Animals used in AAT are dogs, cat, horses and sometimes even dolphins. It is carried out by a specialist with professional training in Animal Assisted Therapy. Animal Assisted Therapy is helpful for children with different disabilities in the following way:

- It helps in social and emotional development
- It modifies the behavior of children
- Develops communication skills in children
- Helps in developing care taking skills
- Helps to overcome sensory defensiveness among children with sensory issues
- Increases attention span
- Enhance problem solving and cognitive skills
- Helps the child to learn about caring and providing unconditional love







Section C: Recent Advances

Chapter 22

New Rehabilitative and Regenerative Technological Advances

"Technology can help achieve any dream"

Extensive research is being conducted in discovering new treatments for neurological disorders in children. They can be used alone or in conjunction with the conventional treatments. However, further studies are required to establish their efficacy.

In this chapter, we have described few of these treatment strategies, namely Spider therapy and Hyperbaric Oxygen Therapy (HBOT)

1. Spider therapy

Spider therapy, developed in Poland, is a strengthening program of Intensive Developmental Exercises and Activities for Reaching Maximal Potential. It involves suspending the child in the centre of a universal exercise unit (UEU) by using different elastic cords of different elasticity. These cords are attached to specific points on a special belt around the child's waist, forming a unique spider web around the child, which provides them with essential support. This allows the child to move independently while controlling their movements with greater precision and ease, as well as strengthening parts of the child's body. Therefore, the spider will help to promote independence with security. It mayhelp improve balance, coordination, and sensory/body awareness in disorders such as cerebral palsy, traumatic brain injury, developmental delay, autism, etc. Spider therapy is an intensive treatment which usually requires six-days-a-week, four-hour-a-day sessions.



2. Hyperbaric Oxygen Therapy

Hyperbaric oxygen therapy involves use of higher pressure to distribute more oxygen into brain, blood, cerebrospinal fluid, etc. It can be used in several neurological disorders such as cerebral palsy, autism, brain injury, etc. The patient inhales 100% oxygen at a pressure three times greater than normal atmospheric pressure in an enclosed, specialized designed,



pressurized chamber. This improves oxygenation of damaged tissues which enhances neurological functions, cognition, memory, etc

Side effects of HBOT include fatigue and lightheadedness. More serious complications can include: Damage to the lungs, buildup of fluid or rupture of the middle ear, damage to the sinuses, changes in vision, causing nearsightedness, or myopia, oxygen poisoning which can cause lung failure, fluid in the lungs, or seizures.

Therefore these therapies should be done by experts only with due precautions.

3. Neurofeedback

Neurofeedback is a noninvasive approach in which the brain is trained to improve its functionality. It is designed to train individuals to enhance poorly regulated brainwave patterns by using sophisticated computer technology.

The procedure involves placing EEG electrodes on the scalp and recording the brain signals with various audio / visual stimuli. There is now a quantitative EEG (QEEG) which identifies the damaged areas of the brain. According to this information, a neurofeedback program specific to train these abnormal areas is prepared. Information on brainwave activity is fed to a computer that converts this information into game-like displays that can be auditory, visual, or both. By using video or sound, a desired brain activity is given a positive feedback and undesired activity is given a negative feedback. Individuals utilize their brainwaves to learn to control the feedback they instantly receive about the amplitude and synchronization of their brain activity. Neurofeedback sessions are usually given over six months to see effectiveness.

Neurofeedback improves neuroplasticity of the brain. It can be beneficial in number of disorders such as ASD, ADHD, cerebral palsy, head injury, GDD, etc. It may improve their common symptoms such as seizures, hyperactivity, attention problems, anxiety, Processing of information, sleep disorders, and obsessive-compulsive behavior.

There are no major side effects of Neurofeedback but some children may have fatigue, nausea, dizziness, irritability etc. Children who do not have a history of seizures may be at a higher risk of getting seizure with neurofeedback treatment. This is still a very new treatment modality and requires an expert in this field. This is also an expensive and a long duration treatment and the results of this treatment are yet to be established.

Brainwaves are displayed on the therapist's computer and goals are set

Sensors are placed on the scalp & ears to read the brain's electrical activity When the brainwave activity meets the set goals, the client gets positive feedback (visual & auditory) to guide their success with the game

4. Chelation

Since many years, chelation has been used as a medical treatment for heavy metal poisoning. In disorders like ASD, mercury and lead toxicity has been recorded which are said to be responsible for typical autistic symtoms. Therefore chelation is one of the treatment options for these children. Dimercaptosuccinic acid (DMSA) or ethylenediaminetetra aacetic acid (EDTA) are commonly used chelators which remove heavy metals from the blood through subsequent urination. These are supposed to be administered on a cyclical basis (series of doses). Elimination of these heavy metals may result in improved language, cognition, and social interaction. However, there are side effects such as renal and hepatic toxicity, fatigue, and diarrhea, abnormal complete blood count, mineral abnormalities, seizures, sulphur like smell, regression, gastrointestinal symptoms and rash associated with this treatment. Hence, the child needs to be evaluated before the treatment and the treatment should be performed only by an expert doctor.

Chapter 23

Stem Cell Therapy For Neurological Disorders

"An idea whose time has come"

Stem cell therapy has emerged as a promising treatment for numerous neurological disorders. It has brought about a revolution in the field of medicine by changing the long-standing belief that brain and spine once damaged cannot be repaired. Yes, brain and spinal cord can be repaired now. In this chapter, we have introduced the basic concepts of stem cells, how it works in children with neurological disorders and clinical evidence in disorders such as autism, cerebral palsy, intellectual disability, Down syndrome, muscular dystrophy and traumatic brain injury.

What are stem cells?

Stem cells are blank cells which are the foundation of every tissue / organ in the human body. They can divide, self-renew and differentiate into specialized cells. When a stem cell divides, each new cell can either remain a stem cell or become another type of cell with a more specialized function, such as a brain cell, nerve cell, muscle cell, or a red blood cell. They exist naturally in different areas of the body and are important for growth, healing, and replenishing the cells lost due to daily wear and tear.



What are different Types of Stem Cells?

Embryonic stem cells:

These cellsare derived from 3-4 days old waste embryos in the IVF clinics. These are most potent, but their use involves ethical and moral issues. Side effects include potential teratoma (benign tumor) formation. They are not allowed for clinical therapeutic purpose in human beings.

Umbilical cord blood cells: Umbilical cord blood is a rich source of stem cells. These cells are stored in cord blood banks and can be revived when required. It is complex procedure of cells isolation processing, separation and storage etc.

Adult stem cells: These cells are derived from adult tissues such as bone marrow, adipose tissue, dental pulp, etc, and are the most used in clinical practice. They have no ethical issues or controversies, are safe for use, especially the autologous cells which are cells from the same patient.

How do stem cells work in children with neurological disorders?

Stem cells which are already present in the body require an internal or an external cue to trigger their differentiation. In neurological disorders, the brain or nerve cells get damaged or are dead which triggers the existing stem cells. However, the existing stem cells are limited in number. Hence, stem cell therapy, which involves administration of stem cells, helps in enhancing the repair process.

Stem cells act in two ways:

- 1. Direct Effects: Direct replacement of damaged or lost cells. Stem cells when transplanted migrate towards the damaged areas of the nervous system. They differentiate into the host tissue cells and replace the damaged/ dead neuronal tissue.
- 2. Indirect Effects: Indirectly through paracrine mechanisms. They secrete growth factors (BDNF, FGF, VEGF) which are responsible for various repair mechanisms such as angiogenesis (forming new blood vessels), antiinflammation, modulating the immune system, halting further damage of the cells, etc



In disorders such as autism, ADHD, ID, Down syndrome, Learning Disability stem cells address the core underlying pathology wherein the neural connectivity is affected due to which there is fault in information processing. They help in reestablishing this connection through different mechanisms such as remyelination, synaptogenesis, etc and thereby restoring lost neuronal functions.

In cerebral palsy, there is permanent damage in the white matter of the brain due to lack of oxygen or blood flow which affects the development of the child and causes motor and physical impairments. Stem cells repair the brain damage by regenerating and replacing the dead white matter cells and also by forming new blood vessels which increase the oxygen and blood supply to the brain. This helps in the motor development of the child and also improves the functional abilities. Similarly, in disorders which involve traumatic or non-traumatic injury to the brain or spinal cord, such as traumatic brain injury, spinal cord injury, transverse myelitis, spina bifida, these cells regenerate and restore the damaged neuronal cells and re-establish the lost neuronal connections.

In neuromuscular disorders, such as muscular dystrophy and SMA, which are progressive in nature stem cells help in muscle regeneration. This either completely halts the disease progression or nevertheless slows it down along with delaying loss of ambulation and increasing their life span.

Through these mechanisms, stem cell therapy helps these children gain functional independence and improves their quality of life.

The benefits of stem cells multiply when they work in combination with multidisciplinary rehabilitation.

How is Stem cell therapy performed in NeuroGen Brain and Spine Institute?

At NeuroGen Brain and Spine Institute, we use autologous bone marrow mononuclear cells (BMMNC) which are extremely safe and effective and involves a very simple and a minimally invasive procedure.

The procedure involves 3 steps:

1. Aspiration: (done in the operation theatre)

This is done by putting a needle into the hip bone, after making the area numb with local anesthetic, so that the patient does not experience pain. 100-120 ml of bone marrow is aspirated from inside the bone which takes about 20 minutes.

2. Purification and Isolation: (done in the stem cell laboratory)

The bone marrow removed from the patient is taken to the Stem cell laboratory, where the stem cells are separated from the remaining cells of the bone marrow by the density gradient method. This takes about 3 hours.

3. Stem cell injection: (done in the operation theatre)

Injection of stem cells into the spinal fluid is done by a very thin needle at lower back level (L4-5 space) after giving local anesthesia. The stem cells are injected this way which takes about 20 minutes.

In special cases, such as patients with muscular dystrophy, stem cells are also injected intramuscularly at motor points.Motor point is a point at which the motor branch of the innervating nerve enters the muscle. It is the point with the highest concentration of motor endplates, myoneural synapses and neuromuscular junctions.

The stem cell therapy is followed by an extensive personalized neuro-rehabilitation program.



Aspiration of cells from the bone marrow



Separation and purification of stem cells



Intrathecal administration of stem cells



Motor point injection



What are our results of stem cell therapy?

At NeuroGen Brain and Spine Institute, we have treated more than 5000 patients with various neurological disorders. These patients are followed up at regular intervals and the outcome of the therapy is analysed in detail. Our results have been published in the form of 73 scientific publication in numerous peer reviewed, national and international medical journals. In this section, we have described our results demonstrating the benefits of stem cell therapy in autism, cerebral palsy, muscular dystrophy, intellectual disability, traumatic brain injury and spinal cord injury.

Autism spectrum disorders

Overall we have treated more than 600 patients with autism. We have published 13 scientific publications showing evidence that stem cells benefit children with autism.

In a study conducted on 193 patients of ASD treated with autologous BMMNCs intrathecal administration, common symptoms such as social interaction, eye contact, hyperactivity, aggressive behaviour, self stimulatory behaviour, speech, attention, stereotypical behaviour and communication were analysed. On follow up we found that, 89.12% of patients showed improvements while 10.88% did not show any change after intervention. No major adverse events were recorded. Children showed improvements on objective scales like CGI – II and III, ISAA and CARS. PET-CT scans also revealed improvements which correlated well with the clinical improvements.



Improvements in Autism after Stem Cell Therapy

Graph representing improvements in Autism after Stem cell Therapy



In the figure, A & B show PET-CT scan images before and after stem cell therapy, respectively. PET-CT scan after Stem cell therapy shows increase in the metabolism as outlined

Cerebral Palsy

Overall we have treated more than 650 cases of cerebral palsy. We have published 9 scientific publications demonstrating the effect of stem cell therapy in cerebral palsy.



Graph demonstrating improvements after stem cell therapy in cerebral palsy.

We analysed the effect of stem cell therapy in 267 patients diagnosed with cerebral palsy. The improvements were graded as no change, mild improvements, moderate improvements and significant improvements. Analysis revealed that out of 267 patients, Overall 91.01% patients showed symptomatic improvements on follow up in common symptoms like oromotor/speech, balance, trunk activity, upper limb activity, lower limb activity, muscle tone, ambulation and Activities of Daily Living. Improvements were recorded in objective scales such as FIM and GMFCS. PET CT scan also showed improvement in brain metabolism in the areas responsible for the above mentioned functions. We observed that patients who continued regular exercise program at home under supervision of professional therapists showed significant improvements. Patients who did not follow regular rehabilitation showed mild improvements.



The blue damaged areas seen in the pre SCT image have almost disappeared after SCT. This shows improvement in the metabolism/functioning of the damaged areas after SCT.

Muscular Dystrophy

Overall we have treated more than 1100 patients with different types of muscular dystrophies. We have published 15 scientific publications showing evidence that stem cell therapy is beneficial in muscular dystrophy.

We conducted a study including 512 patients diagnosed with different types of muscular dystrophies. On follow up, out of 332 patients, 85.74% of patients showed improvements in ambulatory status, hand functions, balance, stamina/fatigue, trunk activation and standing while 14.25% of patients remained stable without deterioration in any of the symptoms.

We further studied the DMD population which included 139 boys. Majority of these patients showed improvement or halting of the progression in posture, neck weakness, bed mobility, trunk activity, gross and fine motor function, functional upper limb activity, walking and standing. There was a statistically significant difference in the time till loss of ambulation between children who underwent stem cell therapy and those who did not.

	Average age when there was loss of ambulation
Children who did not undergo stem cell therapy	142 months
Children who underwent stem cell therapy	204 months



Kaplan-Meier curve analysis of time till loss of ambulation in patients with and without stem cell therapy

Intellectual Disability

Overall we have treated around 250 cases with intellectual disability.

To demonstrate the effect of autologous stem cell therapy in intellectual disability, we analyzed the data of 56 patients. On follow up we found that 86.21 % of patients showed improvements in symptoms such as cognition, remote memory, problem solving, understanding, social inhibition and toilette training. No adverse events were recorded.

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Improvements in ID after Stem Cell Therapy

Improvements seen with intrathecal administration of autologous BMMNCs in patients with intellectual disability.



(A) Pre Stem cell therapy PET CT scan showing blue areas with hypometabolism (B) Post Stem cell therapy PET CT scan showing decrease in blue areas which is replaced by green areas indicating improved functioning of the brain

Down syndrome

Stem cell therapy has shown promising results in Down syndrome. In our experience post stem cell therapy, these children show improvement in cognition, command following, problem solving and judgement. Their ability to learn new concepts such as colors, shapes and directions improve significantly. Some children with Down syndrome have behavioral issues such as aggressive behavior, which parents and therapists have observed to improve after stem cell therapy. Their play behavior and social interaction also improves. Improved speech and communication skills have also been observed in these children along with improvement in fine motor activities. They become more receptive towards their surroundings and their compliance also increases. Their emotional understanding becomes better. These children become independent in their day to day functional activities which improves their quality of life to a great extent.

Traumatic Brain Injury

We have treated around 100 cases of Traumatic Brain Injury. To demonstrate the effect of autologous stem cell therapy in TBI, we analysed the data of 30 patients. On follow up we found that 66.67 % of patients showed improvements in balance, voluntary control, memory, upper and lower limb activity, ambulation, posture, muscle tone, speech , cognition and ADLs. No adverse events were recorded.



Improvements in TBI after Stem Cell Therapy

Graph showing overall improvement in the TBI patients after stem cell therapy



PET CT Scan showing improved metabolic activity which is indicated by decrease in blue areas after stem cell therapy

Spinal Cord Injury

We have treated around 500 cases of Spinal Cord injury and published 7 scientific papers.

Thoracic Spinal Cord Injury:

We analyzed 184 patients with chronic thoracic spinal cord injury to study the effect of stem cell therapy. Analysis revealed that out of 184, 96.19% patients showed improvements in symptoms like muscle tone, lower limb activity, sensory changes, bowel/bladder function, trunk activity, balance, standing, ambulation and activities of daily living.Improvements were also recorded in objective scales such as FIM



Improvements in Thoracolumbar SCI after Stem Cell Therapy

Improvements seen in thoracolumbar SCI after intrathecal administration of autologous BMMNCs.

Cervical Spinal Cord Injury:

104 patients with cervical spinal cord injury were included in the analysis. The. Analysis revealed that out of 104 patients, 96.19% patients showed improvements in symptoms such as muscle tone, upper limb activity, lower limb activity, sensory changes, bowel/bladder function, trunk activity, balance, standing, ambulation and activities of daily living. Improvements were also recorded in objective scales such as FIM



Improvements in Cervical after Stem Cell Therapy

Improvements seen in cervical SCI after intrathecal administration of autologous BMMNCs.

All our publications can be found on www.stemcellspublications.com

How safe is stem cell therapy?

At NeuroGen Brain and Spine Institute, we use autologous bone marrow mononuclear cells which are the safest form of cells used for clinical purposes. Since they are autologous i.e. patient's own cells there is no risk involved in their use. Procedural side effects such as headache, pain at the site of aspiration/injection, fever, nausea, vomiting is seen in few patients. However, it subsides within few days. Some patients with history of seizures or an abnormal EEG are at risk of having seizures after stem cell therapy. But administration of anti-epileptic medications before the therapy can avoid the occurrence of seizures.

What are the factors affecting the results of stem cell therapy?

1. Age of the patient:

The outcome of stem cell therapy is better in younger children as the brain plasticity is maximum in developing years.

2. Severity of disorder:

Effect of stem cell therapy is better in milder forms of neurological disorders which have less damage as compared to severe disorders which may have more brain damage.

3. Chronicity of the disorder:

As more time passes there is more damage or scarring of the tissue and hence administration of stem cells at an earlier stage would give better results.

4. Frequency of stem cell transplantation.

If a disease is progressive, the damage continues and therefore more than one stem cell transplantation will give better results in halting the progression. In diseases which are not progressive, severe damage can be repaired better with multiple transplantations.

5. Rehabilitation:

Rehabilitation therapies enhance the reparative capacity of stem cells. Hence, combination of both stem cell therapy and rehabilitation gives a better outcome.

Stem cell therapy, when combined with available standard treatments and neurorehabilitation, is effective in repairing the neurological damage. In nonprogressive neurological disorders, stem cells stimulate local repair mechanisms and provides functional improvements. Whereas, in progressive disorders stem cells prevent recurrent damage and slows down the disease progression. It is a promising new therapy to improve quality of life of patients suffering from incurable neurological disorders by enhancing neurodevelopment, learning, schooling and independent living.

Case presentations of few of our patients who underwent Stem cell therapy

1. Autism

Master S.S.R, a 10 years old boy diagnosed as Autism with ADHD at the age of 4 years as he was more hyper compared to other children of his age and his speech had also not developed.

- When he came to us his Chief complaints were:
- His attention span was poor.
- He required repeated instructions and was prompt dependent while engaging in any activity.
- His cognition and problem solving skills were not age-appropriate.
- He did not engage in social or functional play.
- He used to laugh without reason.
- Hyperactivity was present.
- There was limited social interaction.
- He engaged in body tensing, playing with strings and ropes.
- His speech was limited.
- He could not engage in reciprocal conversations.
- He engaged in smelling behavior, mouthing behavior and was sensitive to sounds.
- He required assistance while cleaning after toilet.
- He was dependent for his All Day Living activities.

After 6 months of Stem Cell Therapy at NeuroGen his improvements were:

- Eye contact improved.
- Understanding improved.
- Hyperactivity reduced.
- Social interaction was better than before. He tries to interact with other kids.
- Attention and Concentration had improved. His reading and writing was better with proper attention and concentration.
- Cognition and problem solving had improved.
- Awareness and judgment had improved. He had more understanding of the situations and surroundings now. He knew that crossing the road, hot water and fire were dangerous.
- His emotional responses had improved, he could now understand and respond well to the emotions.

- Speech had improved little but understanding of the language of what the opposite person is trying to communicate had improved.
- His Academics have improved. Learnt better and faster now.
- His writing speed, handwriting, calculations, grades in exam have improved.
- He is doing well in school.
- There was slight improvement in fine motor skills as well.
- Behavior problems also reduced considerably.

2. Cerebral palsy

Master D.J., 5 year old boy from southern India was a known case of Cerebral Palsy (Diplegic).

His major complaints were:

- Delayed motor milestone. Overall development of body and learning was delayed.
- He was dependent for transfer from one place to another or from one position to another and he was dependent for moving or shift himself from one place to another.
- He used to sit with stooped posture and had toes pointing downwards in an improper pattern.
- He had tightness in legs, thighs, and calf which restricted his movements further.
- Voluntary control of ankle and foot were poor. They used to move/shake without any reason.
- Trunk and leg coordination for walking was poor. He used to move both of his legs together.
- He used to move both of his legs together and not alternately.
- Balance of standing and walking was poor.
- Gait pattern was abnormal, when made to stand his knees used to bend inwards.
- He used to face difficulty in getting up from bed, difficulty in squatting, inability to stand, climb and walk independently.

- His attention and concentration was Average.
- He could follow basic 1 step commands within his reach.
- His cognition and problem solving was not age appropriate.
- His eye hand coordination was not appropriate.
- He had difficulty in gripping.

Improvements seen after 6 months of Stem Cell Therapy

- He sits in erect manner now.
- Sitting posture had improved. He did not sit with stooped posture anymore.
- His balance as well as reach-outs for things had improved.
- He could walk with one hand support. Earlier he couldn't do it.
- He could do side walking minimum 5 steps each side with 2 hand held.
- Higher mental functions had improved. He could now follow more commands at a time.
- According to mother, grip in left hand had improved and tightness was reduced.
- Walking pattern had improved.
- He had started taking bath and brushing by himself.
- Overall tightness of the body had improved.
- He had started going to school now
- •

3. Intellectual Disability:

Ms. N.P, was a 13 years old female with Intellectual Disability and Behavioral issues. She was diagnosed at the age of 5 years as her parents noticed her unusual behaviour.

When she was assessed by our experts, her complaints were as follows:

- Her attention and concentration was poor. She had attention deficit and would get distracted easily.
- Her command following was affected. She followed only one step basic commands.

- Her cognition was affected.
- Her play behavior was affected. It was not age appropriate. She would hit other children.
- There was presence of inappropriate emotional responses such as laughing without reason.
- There was presence of hyperactivity.
- Her sitting tolerance was poor. She would sit at one place only for 5 to 10 minutes only with an activity.
- Social interaction was present. However she would become over friendly with strangers.
- Aggressive behavior was present in terms of throwing things, hitting others.
- Self injurious behavior was present in terms of biting herself.
- Her speech was present in terms of forming simple sentences however it lacked clarity.
- Her conceptual memory was affected.
- She had an increased appetite
- She would have disturbed sleep.

Clinical improvements noticed after Stem Cell Therapy are as follows :

- Her concentration had improved. Now she could focus on an activity for an hour.
- Remote memory slightly improved.
- Learning had improved. New learning had improved.
- Stereotypical behaviour had reduced and Self biting had stopped.
- Aggressive behavior and hyperactivity had reduced.
- Speech had improved. She could now speak more clearly.
- Play behavior had improved. She played with other children, Understood simple game rules and used toys appropriately.
- Eye contact had improved.

- Sitting tolerance had improved.
- Memory and grasping had improved.
- She had become independent in her day to day activities.
- Self talks had also reduced.
- She helped her mother in house chores such as washing utensils, serving water to guests
- She now can study on her own and completes her homework with little assistance. She can even draw pictures

NeuroGen Brain & Spine Institute



The NeuroGen Brain & Spine Institute is an International center of excellence for Neurological disorders. Founded by Dr. Alok Sharma it Is India's First dedicated Hospital for Stem Cell Therapy and Comprehensive Neurorehabilitation. Located adjacent to the Arabian sea on the scenic Palm beach road in Navi Mumbai, this center has a multidisciplinary team of expert and experienced medical professionals that provide holistic care using the latest technological advances in the world. It has treated over 5000 patients from 50 different countries. The care offered here is very professional yet very caring.

A separate pediatric neurorehabilitation facility and other play areas makes it very child friendly. The institute is very scientific and academic in its approach and to date has published 73 scientific papers in international and national journals. 14 books have also been published and chapters contributed to several international textbooks. NeuroGen also has many international tie ups with leading organizations from America and other countries for research and treatment collaborations. The institute is very quality conscious and has several certifications (1. ISO 9001:2008, 2. GLP & 3. GMP certification). Despite all the international partnerships and treatments offered to patients from all over the world the institute is very socially conscious and through the Stemcare foundation financially supports patients from the lower socioeconomic strata to be able to avail of the treatments that are needed. Its a policy of the institute that no patient should be deprived of any treatment due to financial reasons. NeuroGen doctors conduct free medical camps all over the country. Conferences, workshops and CME's are regularly conducted to impart knowledge to doctors, therapists as well as patient families. Cutting edge research, pioneering new treatments, the best medical professionals, comprehensive treatment facilities all under one roof and a caring holistic approach and make the NeuroGen Brain and Spine institute a unique and special facility for patients with Neurological problems.

NeuroGen Books

Stem Cell Therapy In Pediatric **Neurological Disorders**



Parent & Teacher **Guide Book for Autism** 2nd Edition

Stem Cell Therapy in **Neurological Disorders 3rd Edition**



Patient Guide Book for Cerebral Palsy

Stem Cell Therapy & Other Recent Advances in Muscular Dystrophy



Patient & Parent Guidebook on Muscular Dystrophy **Neurological Disorders** A Handbook for **Family Physicians**



પેશન્ટ અને પેરન્ટ માર્ગદર્શિકા મસ્ક્યુલર ડિસ્ટ્રોફી વિશે



Autis



Neurorehabilitation in Spinal Cord Injury A guide for **Therapists and Patients**





ALS / MND Guide **Book For Patients** & Families





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