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RESEARCH ARTICLE

DENTAL MANAGEMENT OF CEREBRAL PALSY

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Abstract

Cerebral palsy is a term used to describe a group of permanent and progressive disorders affecting movement and posture that result from injury or insult to the developing brain. It is the most common motor disability of childhood, with a worldwide incidence of 1.5 to 3 per 1000 live births. Children with cerebral palsy posses a significant higher risk of dental disease due to the greater difficulty for them to perform effective oral hygiene and care. Dentists dealing with them should possess thorough knowledge of this condition and their implications in order to formulate safe and effective dental preventive and treatment plans.This article will help the dentist to understand all the aspects related to the dental management of patients with cerebral palsy and apply it in clinical practice.

Introduction:-

Cerebral palsy is the most common motor disability in childhood (Cerebral Palsy Alliance Research Foundation, 2018), with a worldwide incidence of 1.5 to 3.0 per 1000 live births.[1,2]The International Concensus (2007) describes cerebral palsy as - A group of permanent disorders of the development of movement and posture, causing activity limitation, that are attributed to non-progressive disturbances that occurred in the developing fetal or infant brain. The motor disorder of cerebral palsy are often accompanied by disturbances of sensation, perception, cognition, communication and behaviour by epilepsy, and by secondary musculoskeletal problem. This disturbances includes respiratory difficulties, speech impairment, oral motor impairment, digestive issues, vision impairment, hearing impairment, learning difficulties and epilepsy.

Oral health in children with cerebral palsy is impacted significantly by their neuromuscular and neurodevelopmental disabilities, leading them to have a higher risk of dental disease due to the greater difficulty for them to perform or receive effective oral hygiene and oral care. In addition parents anxiety in relation to the problem associated with the child's disability frequently delays dental care which causes significant oral disease to develop.[3] It is often a great challenge for a dental practitioner to manage a patient with cerebral palsy and deliver a successful outcome. A detailed knowledge, innovative and problem solving approach play an important role in promotion of the oral health in these individuals. The dentist should also focus on educating and encouraging the parents and the caregivers of the child for good home oral health practice and maintenance of oral hygiene. Once the dentist becomes familiar

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with the special needs of the child and with the parent's concern, the dental management can also be quite pleasing and rewarding.

Definition

Cerebral palsy describes a group of permanent disorders of the development of movement and posture, causing activity limitation, that are attributed to nonprogressive disturbances that occurred in the developing fetal or infant brain. The motor disorders of CP are often accompanied by disturbances of sensation, perception, cognition, communication, and behavior; by epilepsy, and by secondary musculoskeletal problems (Rosenbaum et al ,2007)

Epidemiology

The average incidence of cerebral palsy is estimated to range between 1.5 and 3.0 per 1000 live births. These values change among selected groups of patients, depending on various risk factors. Although there have been some changes in patterns of cerebral palsy in the last four decades in developed countries, there has been a disappointing lack of significant decrease in frequency of CP. The numbers of children with more severe forms of CP are increasing, mainly in the group born prematurely as a result of greater survival of these children to an age when CP can be diagnosed.[4] Researchers have theorized that a greater incidence of multiple births and increased survival rates for extreme low birth weight infants in recent years may account for some of this inability to lower CP rates. An estimated 87% to 93% of children who have CP are now living into adulthood, which increases prevalence in the adult population.

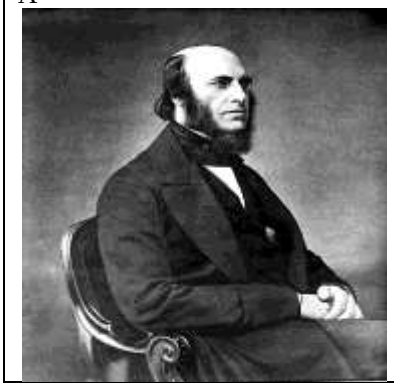
History

Dr.William John Little, an English surgeon was the first person to study cerebral palsy extensively. In 1853, he published lectures in a monograph entitled, ''On the Nature and Treatment of the Deformities of the Human Frame''. This was perhaps the first book dedicated entirely to the subject of deformities in children, which later came to be known as cerebral palsy. He highlighted that the condition was caused by problems during delivery and believed that it resulted from post-partum asphyxia, which distorted the blood flow and in this way damage the child's brain.

It was until 1887 that the term cerebral palsy was applied to the condition that Dr. Little studied. The term was coined by Sir William Osler, who wrote a book entitled " Cerebral Palsies of Children".[5] To some extent, Osler agreed with Little on the etiology of cerebral palsy. He favored the hypothesis that trauma leading to ''meningial hemorrhage and compression of brain and spinal cord'' was a major cause of cerebral palsy.

The third major contribution to the cerebral palsy literature was that of Sigmund Freud (1856–1939). Agreeing with Little, Freud asserted that asphyxia and birth trauma could lead to brain damage; however, Freud went a step further. Extending Little's explanations, he noted that since the same abnormal processes of birth frequently produce no effects, diplegia still may be of congenital and may be merely a symptom of deeper effects influencing the development of the fetus. He proposed that difficulties during labor and delivery, including asphyxia might be the result of early developmental defects of the brain rather than the causes of cerebral palsy

A



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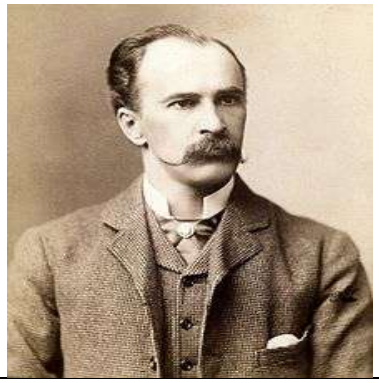


C

Fig1:-(A,B,C): A:Dr.William Little John(1810-1894), B:Dr. williamosler (1905-1919), C:Dr. Sigmund Frued (1856-1939).

Classification

A. **Based On The Body Parts Impaired**

1. Quadriplegic: All four limbs affected
2. Diplegic: Both the legs affected, legs are more severely impaired than the arms.
3. Hemiplegic: Arm and leg on one side affected
4. Monoplegic: Any one limb affected
5. Triplegic: Both the legs and any one arm affected

B. Based on area of brain damaged

1. Spastic: Increased stiffness in the muscles**.** Spastic CP is the most common form of the disorder. It occurs due to the damage to the cerebral cortex of the brain.
2. Dyskinetic: Abnormal movements of the body**.** Dyskinetic cerebral palsy occurs when, basal ganglia, the part of the brain responsible for controlling the voluntary movements is damaged
3. Ataxic : Clumsy movements and poor balance, caused due to damage to the Cerebellum.
4. Hypotonic: Hypotonic cerebral palsy also occurs when there is injury to the Cerebellum. Hypotonia is opposite of spasticity.
5. Mixed: Mixed cerebral palsy is when the symptoms of two or more of the above types co-exist.

C. **Functional Classification System**

1. **Gross motor function classification system (GMFCS)** :

The GMFCS is a simple, five-level, ordinal grading system created to describe the gross motor function of an individual with CP. The five levels are :

a. Level I-Walks without limitations.
b. Level II-Walks with limitations.
c. Level III-Walks using hand-held mobility device.
d. Level IV-Self mobility with limitations; may use powered mobility.
e. Level V-Transported in a wheelchair.(Fig:2)

2. Manual Ability Classification System (MACS) :

MACS is used to describe the typical use of both hands and upper extremities for children from 4 to 18 years of age. It is also a simple, five-point ordinal classification system

a. Level I-Handles objects easily and successfully
b. Level II-Handles most objects but with somewhat reduced quality
c. Level III-Handles objects with difficulty, needs help to prepare and/or modify activities
d. Level IV-Handles a limited selection of easily managed objects in adapted situations
e. Level V- Does not handle objects

3. Communication function classification system (CFCS):

The CFCS classifies the everyday communication performance of an individual into five levels.[6]

a. Level I- Effective sender and receiver with unfamiliar and familiar partners
b. Level II-Effective, but slower-paced sender or receiver with unfamiliar and familiar partners.
c. Level III-Effective sender and effective receiver with familiar partners.
d. Level IV- Inconsistent sender and/or receiver with familiar partners.
e. Level V-Seldom effective sender and receiver with familiar partners.

4.The Eating and Drinking Ability Classification System (EDACS) :

The EDACS assesses the eating and drinking safety and eating and drinking efficiency. It also comprises of levels:

a. Level I-Eats and drinks safely and efficiently
b. Level II-Eats and drinks safely but with some limitations to efficiency
c. Level III-Eats and drinks with some limitations to safety, may also be limitations to efficiency
d. Level IV-Eats and drinks with significant limitations to safety
e. Level V-Unable to eat and drink safely-tube feeding may be considered to provide nutrition.

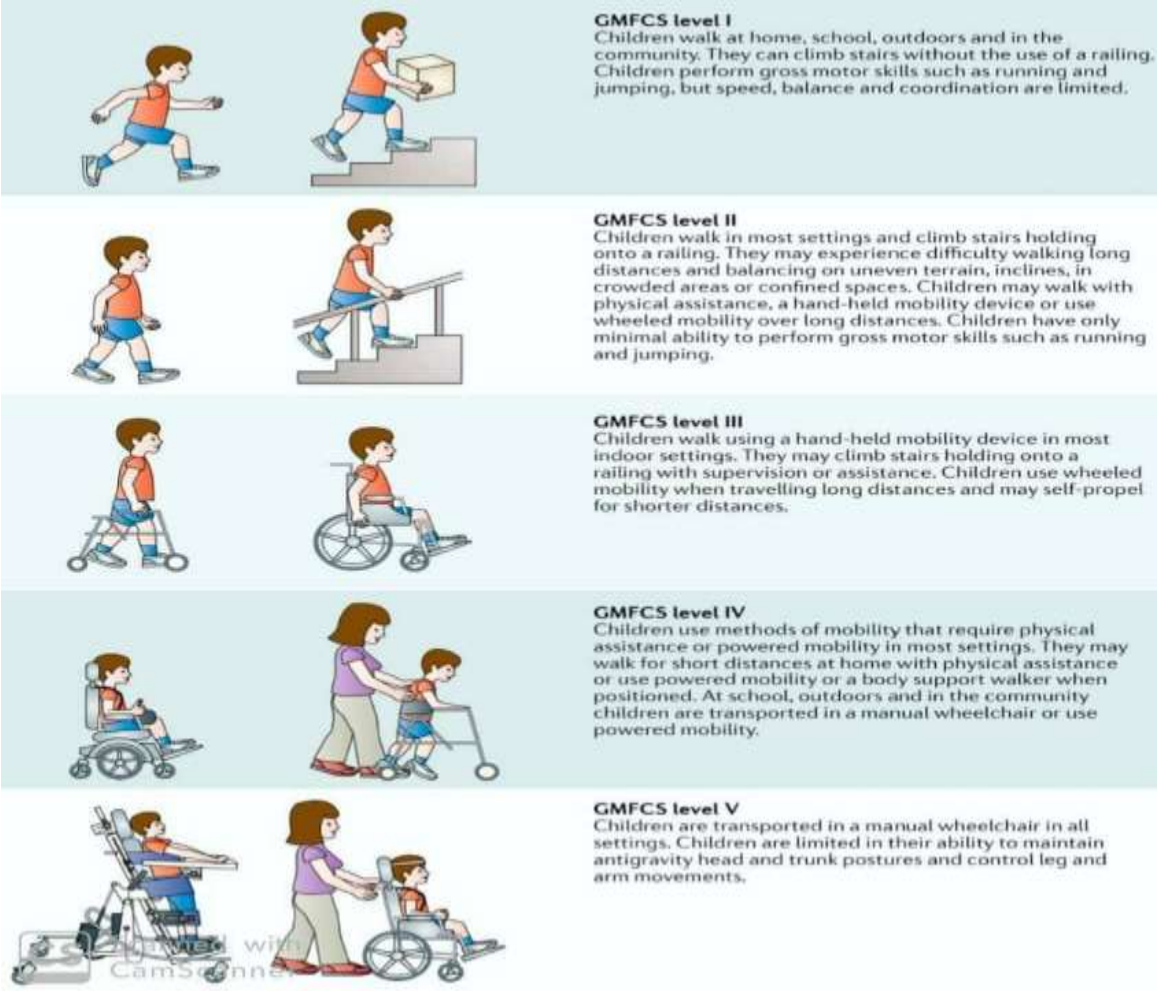


Fig 2:- Gross motor function classification system (GMFCS).

Etiology

Following is the brief overview of the causes and risk factors for cerebral palsy.

1. Prenatal (Before birth)

Causes:

Abnormal development of brain and brain malformations – These are also known as congenital malformations Some examples are :Schizencephaly , Cerebral dysgenesis and Chromosomal abnormalities.

Risk Factors

a. Infection to the mother - Rubella, Cytomegalovirus and Toxoplasmosis.[7,8]
b. Intrauterine infection
c. Medication - medications like Phenytoin, that is used to treat epilepsy
d. Teratogens- alcohol, nicotine, cocain ETC
e. Injury to fetal brain

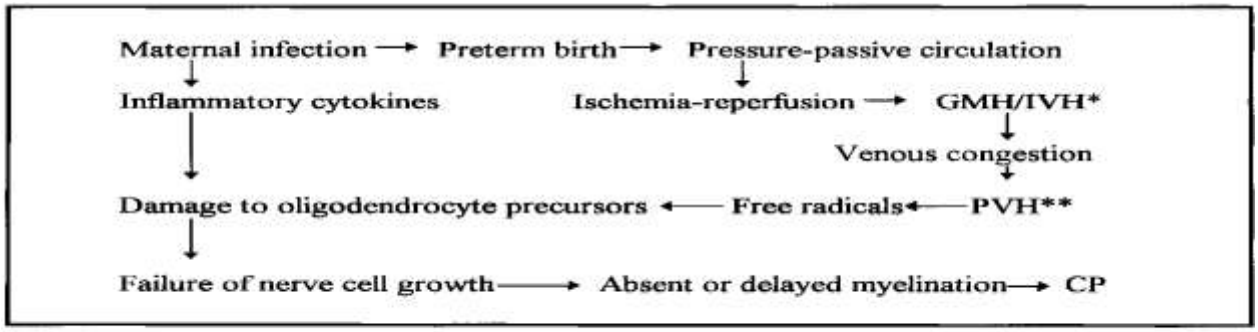
2. Labor and delivery (natal)

Risk factors

a. Prematurity –The underlying basis of most neurodevelopmental sequelae in the preterm infant is white matter damage, collectively called perinatal leukoencephalopathy. This term encompasses germinal matrix hemorrhage(GMH), periventricular hemorrhage(PVH), intraventricularhemorrhage(IVH), periventricular hemorrhagic infarction, and periventricular leukomalacia (PVL). Preterm infants are prone to GMH, PVH, and

IVH because their cerebral circulation is sensitive to changes of blood pressure. Large GMH/IVH, in turn, causes obstruction of the terminal veins, resulting in hemorrhagic infarction.[9] Loss of oligodendrocytes affects nerve cell growth, which, in turn, impairs myelination.(Fig:3)

b.



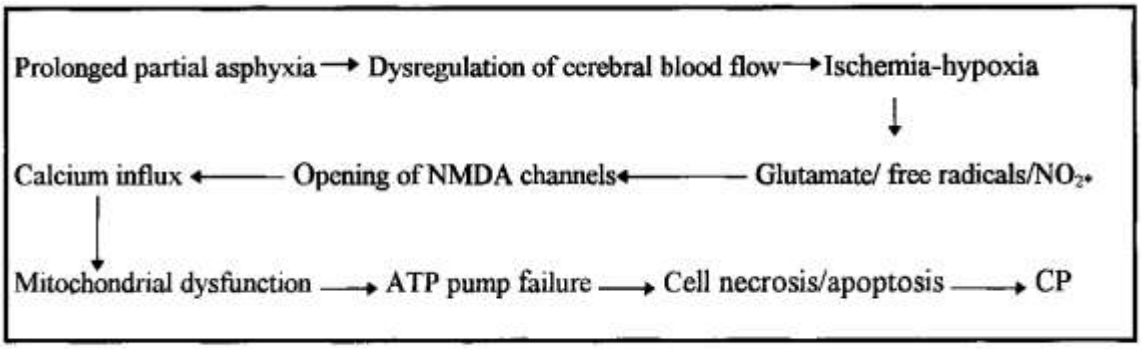
* Germinal matrix/intraventricular hemorrhage
** Periventricular hemorrhage

Fig 3:- Events leading to cerebral palsy in preterm infant.

c. Low birth weight - Children weighing less than 2500 gms
d. Injury at birth – due to use of devices for delivery, use of suction to assist in delivery, rupture of uterus and breech presentation (baby is in the inverted position in the uterus)
e. Multiple births - Twins, triplets, and other multiple births have a higher risk for CP.
f. Infection.

3. Perinatal (Immediately after birth)
Risk factors

a. Asphyxia (lack of oxygen) – Birth asphyxia refers to lack of oxygen supply to the infant brain. It occurs when the organ of gas exchange (placenta or lungs), fails at the time of birth, resulting in oxygen deprivation (hypoxia), hypercarbia, and metabolic acidosis. Asphyxia leads to alterations in cerebral blood flow in a homeostatic attempt to maintain circulation to more vital areas. There is no damage if blood flow to the brain is maintained. If, on the other hand, blood flow is compromised (ischemia), depriving oxygen supply, cell death results due to release of free radicals and amino acids such as glutamate.[8](Fig 4)



* Nitric oxide

Fig 4:- Events leading to cerebral palsy in term infants due to birth asphyxia.

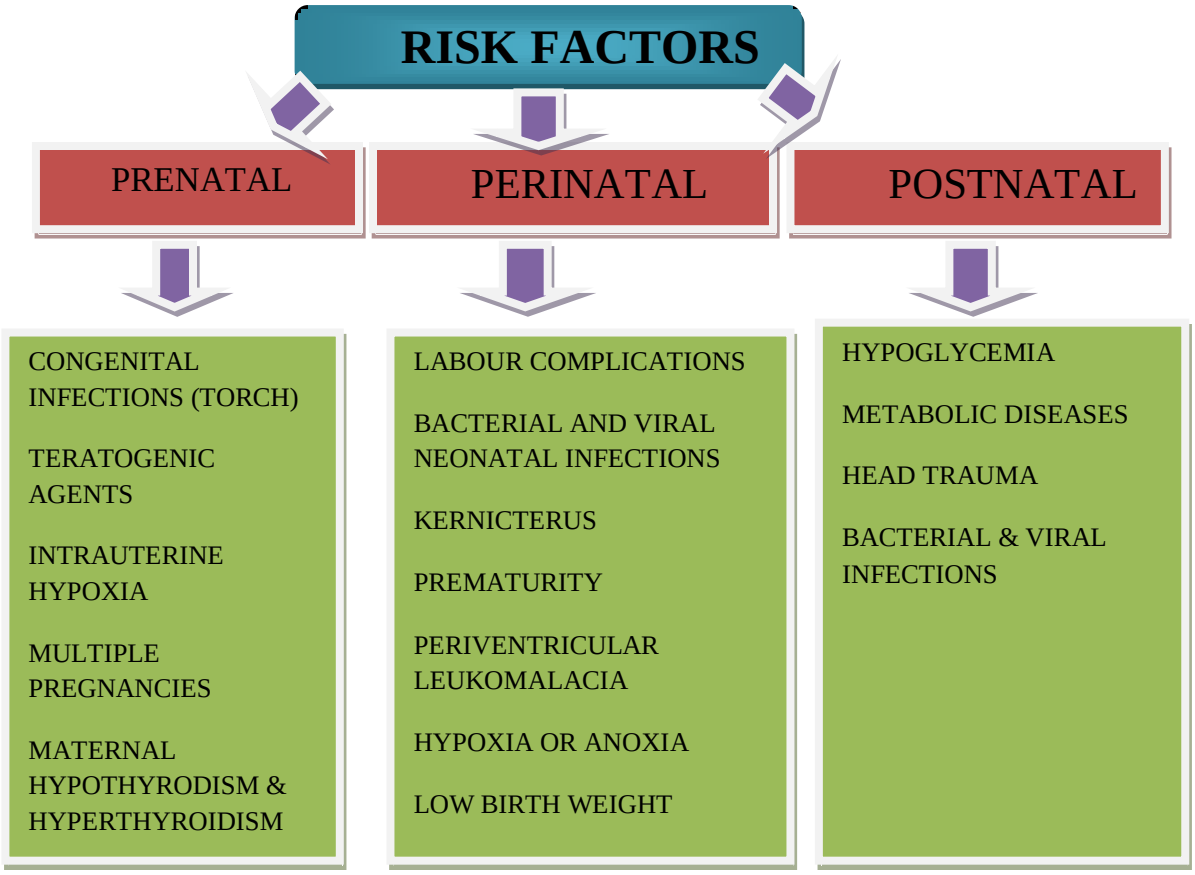
b. kernicterus– Neonatal jaundice is the most common complication of the newborn period, usually caused by unconjugated hyperbilirubinaemia
c. Epilepsy –. A seizure may cause irreversible brain damage. Epilepsy is often associated with cerebral palsy.
d. Hydrocephalus - Hydrocephalus is a condition where there is excessive accumulation of fluid in the ventricles (cavities) of brain.

4. Early Childhood

a. Traumatic Brain Injury (TBI) – Injury to the head or brain of a child due to physical trauma (falls, accidents etc.) may result in cerebral palsy..

b. Infections – Infection to the brain of the infant like meningitis and encephalitis

c. Epilepsy – Seizures that occur within the first year of life may lead to severe irreversible brain damage leading to cerebral palsy(Flowchart 1).



Flowchart 1:- Risk factors and aetiology of cerebral palsy.

Clinical Signs And Symptoms

Cerebral palsy is a disorder with a diverse clinical picture. The signs and symptoms vary depending on the type and severity of the brain damage. The signs of cerebral palsy are the effects that can be observed and tested by the clinician. The symptoms of cerebral palsy differ in type and severity from one person to the next, and may even change in an individual over time. Common symptoms exhibited by children with cerebral palsy includes:

1. Lack of muscle coordination when performing voluntary movements (ataxia).
2. Stiff or tight muscles and exaggerated reflexes(spasticity).
3. Walking on the toes, a crouched gait, or a "scissored" gait.
4. Variations in muscle tone, either too stiff or too floppy.
5. Difficulties swallowing or speaking.
6. Shaking (tremor) or random involuntary movements.
7. Delays in reaching motor skill milestones(Table 1)
8. Difficulty with precise movements such as writing or buttoning a shirt.[10]

Gross motor skill	Mean age of development	Abnormal if not present by:
Lifts head when prone	1 month	3 months
Supports chest in prone position	3 months	4 months
Rolls prone to supine	4 months	6 months
Sits independently when placed	6 months	9 months
Pulls to stand, cruises	9 months	12 months
Walks independently	12 months	18 months
Walks up stair steps	18 months	24 months
Kicks a ball	24 months	30 months
Jumps with both feet off the floor	30 months	36 months
Hops on one foot with holding on	36 months	42 months

Table 1:- Gross motor developmental milestones.

Early signs of cerebral palsy

1. The child may develop difficulties in feeding, sucking and swallowing.
2. The child may show slower or delayed development compared to other children.
3. Child's body may stiffen when carried, dressed, washed, or during play.
4. It may be difficult to carry the child as the body is too flail and floppy.
5. The arm and leg movements of the child are diminished and the child may find it difficult to grip the toes or his hands.
6. The child may show some signs of impaired communication. The child may not respond when his name is called.
7. The child may not be able to use both his hands together in a coordinated manner .

Signs associated with variation in the tone of the muscles

The most common and easily noticeable sign of cerebral palsy is abnormal muscle tone. The tone of the muscles is the tension in the muscles required to bring about movement.

Abnormalities of the tone are demonstrated as following signs:

Hypotonia– Characterized by reduced tension in the muscles, exhibited as flaccid, relaxed and floppy babies

Hypertonia – Characterized by increased muscle tension. The movements are slow and laborious and sometimes not possible as the antagonist muscles fail to relax.

Dystonia – Dystonia is characterized by fluctuating muscle tone. At rest the tone may seem normal but initiation of voluntary activity may lead to sudden stiffness.

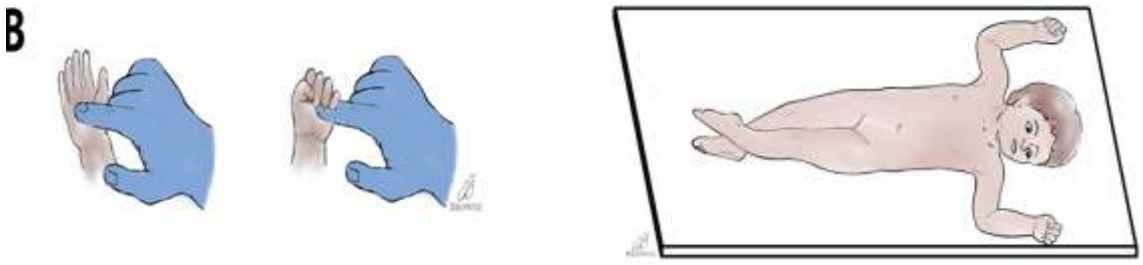
Mixed tone– In some children arms and legs may show increased tone on voluntary movement whereas the trunk may be hypotonic.

Clonus – clonus is uncontrolled jerky muscle contractions that cause rapid tapping movement of the feet or flapping movement at the wrist.

Signs associated with abnormal reflexes

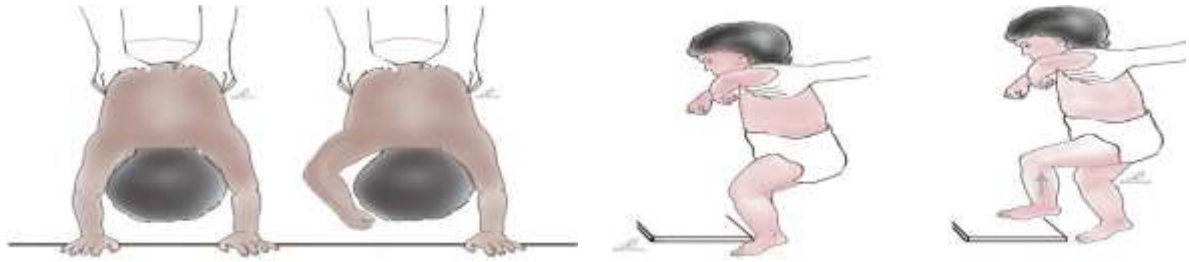
Infants with cerebral palsy have been known to manifest persistence or delay in the disappearance of primitive reflexes and pathologic or absent postural reactions. Some of the common reflexes that may persist till later in the childhood are as follows(Fig5):

- Palmer grasp reflex – This reflex should disappear between 4 to 6 months. It is characterized by closing of the fist as the palm of the infant is touched.
- Tonic labyrinthine reflex – This reflex should disappear by three and half years of age. The tonic labyrinth reflex shows the baby with abducted shoulders, flexed elbows, adducted extended hips, and extended knees and ankles. This posture primarily occurs with the baby in the supine position.



Palmer grasp reflex Tonic labyrinth reflex

Moro reflex(startle reflex) Assymetrical tonic neck reflex



Parachute reaction Foot placing reflex

Fig 5:- Some of the common reflexes that may be absent or persist till later in the childhood.

1. Moro (startle) reflex – Moro's reflex usually integrates in 6 months. The Moro reflex is initiated with a loud noise, that causes the child to have full extension of the head, neck, and back. The shoulders abduct and the elbows extend. The legs also have full extension. After a short time, the pattern reverses and the head, neck, and spine flex; the arms are brought to the midline; and the legs flex.
2. Asymmetrical tonic neck reflex – Usually this reflex should disappear at the age of 6 months. This reflex characterized by straightening of the arm and legs on the side where the neck turns and flexing of elbow and knee on the opposite side.
3. Parachute reaction – It is initiated by holding the child at the pelvis and tipping his head down. As the child is lowered toward the floor, he extends the arms as if he were going to catch himself with his arms. This self-protection response should be present by 11 months of age.
4. Placing reflex – This reflex should disappear by 5 months. As the infant is held upright and the heels touch the surface of the ground the legs curl up.

Associated Conditions

While the motor deficit in cerebral palsy is predominant, a number of associated conditions are frequently present and must be considered in the overall developmental needs of the affected child.A systemic review in 2012[11]comiled

information on the rates of co-occuring impairments, diseases and functional limitations in children with cerebral palsy. The result showed:

1. 3 in 4 were in pain
2. 1 in 2 had an intellectual disability
3. 1 in 3 could not walk
4. 1 in 3 had a hip displacement
5. 1 in 4 could not talk
6. 1 in 4 had epilepsy
7. 1 in 4 had a behaviour disorder
8. 1 in 4 had bladder control problems
9. 1 in 5 had a sleep disorder
10. 1 in 10 were blind
11. 1 in 15 were tube-fed
12. 1 in 25 were deaf (Fig 6)

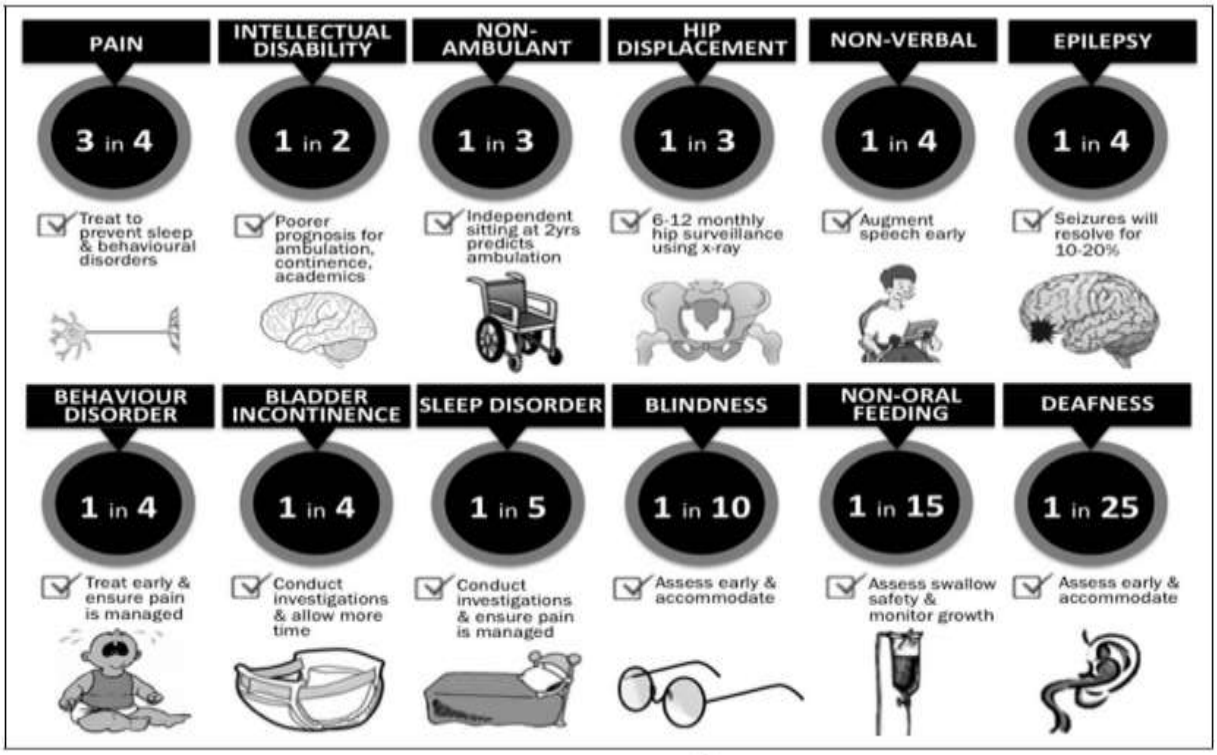


Fig 6:- the comordities of cerebral palsy and evidence based treatment.

Diagnosis

The diagnosis of cerebral palsy involves the following steps:

a. **Observations by parents**: It is important for the parents to observe the child for presence of any of the early signs and symptoms of cerebral palsy. If the child presents with any of suspected signs or symptoms, attention needs to be sought.
b. **Birth history**: A detailed birth history should be taken in which series of questions regarding the risk factors for cerebral palsy are asked to identify the probable risk factors.
c. **Developmental history**: The developmental history of the child is asked to find out about any delay in performing motor tasksin comparison with normal standards.
d. **Motor examination**: A detailed physical examination is carried out to evaluate ability to perform various motor tasks, variations in the tone of muscles, impaired coordination and presence of abnormal involuntary movements.
e. **Reflex testing**: Clinician will then check for the presence of any abnormal reflexes or persistence of primitive reflexes later than the normal age.

f. **Administering special tests**: If there are any abnormalities identified in the above, special investigations such as MRI and CT scan are done to identify the cause and the area of brain damage.

The diagnosis of CP however is not always straightforward. Only those Children who are severely affected, or who have a known risk factor, are diagnosed at an early age. Children with mild symptoms are often diagnose very late. Early diagnosis of CP is important. It enables timely access to diagnostic specific early intervention when the greatest neuroplastic gains are possible. The 3 tools with best predictive validity for detecting cerebral palsy at an early age, before 5 months' corrected age are:

(1) Magnetic resonance imaging (MRI) (86%-89% sensitivity)
(2) The Prechtl Qualitative Assessment of General Movements (GMs) (98% sensitivity) and
(3) The Hammersmith Infant Neurological Examination (HINE) (90% sensitivity)[12]

1. Magnetic Resonance Imaging:

Magnetic resonance imaging (MRI) is an important tool in the assessment of a child with cerebral palsy (CP). It is usually recommended as the first diagnostic step after medical history taking. Brain MRIs have been reported to detect abnormal findings in about 85–86% of children with CP. Subtle white matter lesions, myelination of the posterior limb of internal capsule (PLIC), and cerebellar lesions are findings for which brain MRI is superior to other imaging modalities. Mercuriet al.[13] reported that the myelination of Posterior limb of internal capsule is a good predictor of motor outcome.

2. Prechtl Qualitative Assessment Of General Movements(GMs):

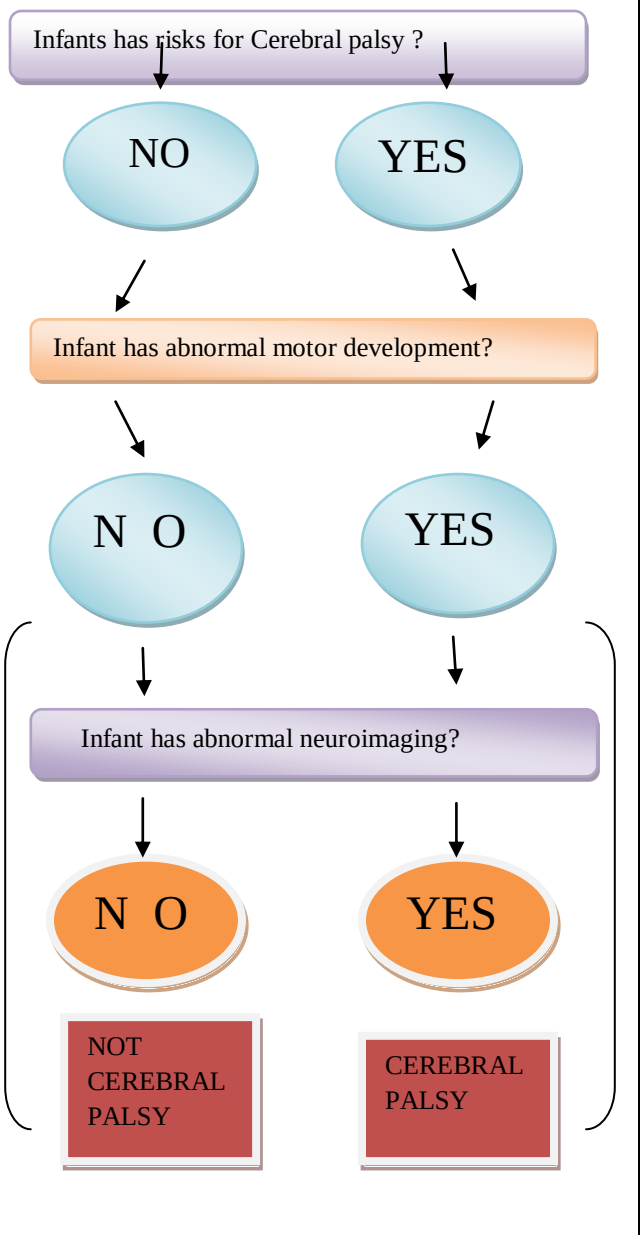
The Hans Prechtl assessment of general movements(GMs) is considered as the gold-standard method in the early diagnosis of CP, with 98% of specificity and 95% of sensitivity at three months. The Prechtl method is based on the qualitative analysis of the infant's spontaneous movements at three different stages :

1. the preterm period starting from the 26th week
2. the full-term period at approximately the 40th week in corrected age, and
3. nursing infants, that is, at 12 weeks calculated from the 40th week.

From 11 to 16 weeks post birth, GMs present as so-called fidgety movements that are described as being a continuous stream of small and fluent movements occurring irregularly over the body. The appearance of fidgety movements represents a phase in the re-organization of motor function that leads to the goal-directed motor activities. According to various research evidences, absent or abnormal fidgety movements are predictive of CP with 95–98% accuracy. Combining GMs with brain MRI has reportedly led to sensitivity and specificity of up to 100% in a cohort of extremely preterm infants.[12,14]

3.Hammersmith Infant Neurological Examination (HINE)

The HINE is a simple, scoreable, standardised clinical neurological examination for infants between two and twntyfour months of age. It assists in the early detection, diagnosis and prognosis of infants at risk of developing cerebral palsy. There are three parts of HINE , a neurological examination (which is scored), developmental milestones and behaviour (which is not scored). The scoreble neurological examination includes twenty-six items divided into five domains, assessing cranial nerve function, posture, quality and quantity of movements, muscle tone and reflexes and reactions. Each item is scored individually (0,1,2 or 3). A subcore can be given for each section and the overall score is calculated by summing up all the twenty-six items (Range 0-78) with higher scores indicating better neurological performance.



RISK FACTOR
MATERNAL RISKS : Thyroid, preclampsia, infection, multiple births, placental abnormalities
BORN PREMATURE : < 28 WEEKS (10%) < 37 WEEKS(0.7%)
TERM BORN: Encepalopathy, head injury, healthy with no known risks

MOTOR ASSESSMENT
AGE: 20 WEEKS (CORRECTED)
GENERAL MOVEMENTS ASSESSMENT : 95% predivtive. An abnormal score of " cramped synchronized" before 8 weeks corrected , followed by an abnormal score of "absent fidgety" at 10-20 weeks corrected age is 98% predictive of cerebral palsy
HAMMERSMITH-INFANT NEUROLOGICAL ASSESSMENT(HINE) : GMFCS III –IV score <40 GMFCS I-III SCORE 40-60 90% predictive of cerebral palsy

ABNORMAL NEUROIMAGING
Periventricular white matter injury Cerebral malformation Grey matter injury Intracranial hemorrhage Infection Non specific

Flowchart 2:- Evidence-based decision-making algorithm for diagnosing cerebral palsy early.

Management Of Cerebral Palsy

Unfortunately, there is no cure for CP. It is a lifelong disorder that requires a range of long-term therapies and interventions. The goal of management of cerebral palsy is therefore not to cure or to achieve normalcy but to increase functionality, improve capabilities, and sustain health in terms of locomotion, cognitive development, social interaction, and independence. This is best done by early, intensive management via a mulidisciplinary team approach. A modern team approach focuses on total patient development, which encompass rehabilitation, pharmacologic treatments, surgical treatments, mechanical aids, and management of various associated medical conditions.

1. Rehabilitation

A. Physical Therapy

One of the first interventions recommended for a CP patient is physical therapy. Physical therapists (PT) are health care professionals specializing in movement that aims to optimize quality of life through exercises, hands-on care, and education (American Physical Therapy Association, 2019). Physical therapists will begin by doing an initial assessment of the patient to evaluate what skills will need to be addressed for each patient and come up with a plan of care. Physical therapists prescribe individualized plans of care for patients with a goal of managing pain, promoting movement, increasing function, and decreasing chances of future complications. Various physical therapy includes :

i. Gait analysis

Gait analysis is a systematic measurement used to identify and evaluate human movement. Modern gait are based on four disciplines: Visual inspection, quantitative analysis, biomechanical analysis and electromyography(EMG). Observing the patient's gait analysis enables the physical therapist to watch the patient's coordination, balance, strength, posture, flexibility and endurance all at once.

ii. Constraint-induced movement therapy

It involves restraint of the unaffected limb to encourage the use of affected limb during the therapeutic tasks. This is particularly useful in management of hemiplegic patient, wherein the patient tends to use only the limb that is unaffected.

iii. Hand-arm bimanual intensive training (HABIT)

It is also benificial for hemiplegic CP where the child is trained to use both hands together through repetitive tasks such as drumming, and pushing a rolling pin.

iv. Electrical stimulation

The electrical stimulations used to increase muscle strength in children with CP are neuromuscular electric stimulation and threshold electrical stimulation (Kerr et al., 2004). [15]

B. Occupational Therapy

An occupational therapist works with patients to develop the skills needed for activities of daily living . Activities of daily living typically include self-care (grooming, dressing, feeding, etc.), play, and fine motor skills (writing, holding small items etc.) (Rezaie&Kendi, 2020). An Occupational therapist will spend more time on smaller, fine motor skills such as the movement of the fingers as opposed to a physical therapist who tends to work on bigger, gross motor skills such as walking. However, this does not mean that there will never be any overlap between these two—an occupational and physical therapist can both be working on the same skills with the patient (Cerebral Palsy Guide, 2020).

C. Speech Therapy

Another type of intervention commonly utilized by patients is speech and language pathology, or speech therapy. Speech therapy has a goal of improving the patient's capacity for communication, saliva control, and eating, drinking, and swallowing (Cerebral Palsy Alliance Research Foundation). Speech and language therapists observe, diagnose, and treat the communication disorders associated with CP. Speech therapist help improve your child's ability to speak clearly or communicate using alternative means such as an augmentative communication device or sign language. They may also help with difficulties related to feeding and swallowing.

2. Drug Treatments

Some of the most common oral medications prescribed for CP patients are: centrally acting drugs such as Baclofen and Tizanidine; peripherally acting drugs such as dantrolene sodium; and anticonvulsants such as Benzodiazepines and Diazepam. Medications may also be administered through injections or pumps, which include botulinum toxin injection, intrathecal baclofen pump, and alcohol or phenol injections—that all have chemodenervation effects (Chang et al., 2013).

3. Surgery

Though this is typically not the first intervention chosen, surgical procedures are still an option for some CP patients. Surgery is discussed with the patient's health care team and caregiver(s) when the other treatment interventions are no longer helping the patient. The common operations include muscle lengthening, tendon lengthening, tendon transfer, tenotomy/myotomy, osteotomy, arthrodesis, selective dorsal rhizotomy, and operations to address comorbidities of CP such as cochlear implants and gastrostomy (Cerebral Palsy Guide, 2020).

4. Orthotics, Adaptive Equipments, And Assistive Technology

According to the United States Individuals with Disabilities Education Act (IDEA), the term "assistive technology device" means any item, piece of equipment, or product system, whether acquired commercially off the shelf, modified, or customized, that is used to increase, maintain, or improve functional capabilities of a child with a disability.[3] (Table 2)

5. Management Of Associated Problems

Various members of the team are involved in the management of associated problems. The clinical psychologist helps with management of behavior problems using behavior modification techniques, psychotherapy, family counselling, etc. The orthopedic surgeon helps with prevention and correction of musculoskeletal problems, e.g., braces to prevent scoliosis, tendon release and lengthening, etc. The audiologist and ENT specialist takes care of hearing and speech problems, provision of hearing aids. The ophthalmologist provides remedies for oculovisualproblemscorrective glasses, squint surgery, etc. High technology devices like electronic feeding devices, computerized speech systems and cochlear implants are available for children with CP in Western countries.

Category	Examples
Daily living activities	Assistance for activities of hygiene, housekeeping and all other activities
Building structure	Lifts and elevators, special ramps, special devices for doors
Communication	Various types of augmentative and alternative communication devices, communication boards, talking books
Computers	Hardware, software, accessories, other modifications and related special devices
Ambulation and transportation	Walking or standing aids, wheelchairs, vehicle lifts
Living conditions	Accessible and modified furniture
Orthotics and prosthetics	Various types of braces, artificial limbs, other prosthesis
Leisure activities	Modified sport equipment, accessible toys
Hearing aids	Hearing aids, assistive listening devices, aids for deaf-blind
Vision	Vision aids, Braille note takers
Orthoses	Ankle-foot, ankle-foot-knee, ankle-foot-knee-hip, lumbar, thoraco-lumbo-sacral, hand splints, shoe inserts

Table 2:- Examples of orthoses, adaptive equipment and assistive technology devices.

Dental Management

Children with CP are more prone to caries, periodontal disease, inadequate oral hygiene, and decreased access to daily preventive care and routine dental visits. To compound this problem, delivery of dental care for these patients can be challenging.Consequently, dentists dealing with them should possess thorough knowledge of the medical and orofacial abnormalities and their implications and should liaise with different medical specialists in order to formulate safe and effective dental preventive and treatment plans.

The latest revised recommendations (AAPD) to reduce the risk of developing oral diseases and oral health care for children with Special health care needs (SHCN) include:

(1) Establishing dental home at an early age.
(2) Patient assessment.
(3) Creating an environment conducive for the child to receive care.
(4) Providing comprehensive oral health education and anticipatory guidance to the child and caregiver.

(5) Providing preventive and therapeutic services including behavior guidance and a multidisciplinary approach when needed.
(6) Attention to detail for all aspects of care including scheduling appointments, assessment, treatment planning, consent, education and anticipatory guidance, treatment, recalls, and transition of care when the patient reaches adulthood.

Some Important Considerations During Dental Examination And Treatment Of A Child With CP:

1. The dental chair must be adjusted carefully, and most of these patients are best treated with the chair tipped back to give a position of security, especially to those with ataxia. The spastic type of a patient having fairly severe head-and-neck involvement will require even more control and support and can be achieved by seating the child in knee to knee position of the dentist and the parent/caregiver(fig6)
2. If the patient is using a wheelchair, he/she should be considered to be treated in the wheelchair itself.
3. The first dental visit should be used mainly to establish mutual confidence and have a preliminary assessment. The following appointments should be made early in the day so as to allow sufficient time to establish appropriate interaction between the child and the dentist.
4. Open mouth can be obtained and maintained with the use of mouth props
5. The dentist should try to be gentle and caring, and he should avoid sudden movements which may trigger muscle stiffening or spasm.
6. A finger guard and a use of steel mirror are preferred to avoid injury. Sharp instruments when used should be used with extreme caution so as to prevent injury.
7. The approach should be a team effort involving mutual efforts between dentists, hygienist, assistant, patient, family, and other persons who are having impact on patient's life. [16]

Fig 6:- The knee-to-knee position for toothbrushing and examination.

Management of common oral conditions in children with cerebral palsy

Bruxism

Bruxism is a common occurrence in children with CP. There is no definitive treatment or cure for bruxism, and it is important to recognize the reasons behind each patient's habit in order to choose an effective treatment modality. Mouthguards can be used to protect the teeth but they will not stop or cure the condition. Botulinum toxin has been used with some success in children and adults with CP. Cognitive and behavioral approaches (stress reduction, counseling, lifestyle changes, etc. show promise, but at this point, there are many limitations to their application.

Sialorrhea

Sialorrhea (drooling or ptyalism) refers to unintentional saliva leakage outside of the mouth. It is considered normal physiological phenomenon in healthy infants. It typically diminishes by 1.5–3 years of age, at the time of maturation of orofacial motor functions. Persisting beyond age of 4 years, the salivary incontinence is deemed pathological.

1. Anticholinergic medicaments, such as atropine,scopolamine/hyoscine, and glycopyrronium bromide can be prescribed to reduce the saliva production.
2. Botulinum toxin injections: A recent study by Hung AS et al, 2021[17] concluded that botulinum A injections are a safe, reversible, effective treatment for drooling control in children with cerebral palsy that can offer effectiveness for more than 3 months with few side effects.
3. Surgical management: Surgery is irreversible and should be undertaken only in severe cases where other alternatives have been proved unsuccessful.

Dental Erosion

Dental erosion is defined as an irreversible loss of tooth structure associated with chemical dissolution of hydroxyapatite crystals, caused by extrinsic or intrinsic acids, without involvement of cariogenic microorganisms or acid produced by plaque bacteria. Medical referral can help with management of GERD, modification of dietary choices, and reduction of harmful habits and behaviors. Dental management involves enhancement of protective factors and improvement of salivary mechanisms. Topical application of fluoride agents and remineralizing products [e.g., casein phosphopeptide–amorphous calcium phosphate (CPP–ACP)][18] can improve the resistance of the tooth structures to acidic challenges. Regular patient recall for professional fluoride therapy and prescription of high-concentration (5000 ppm) fluoride toothpaste can also help prevent dental erosion.

Dysphagia

Difficulty in swallowing or dysphagia is a condition in which muscles used for swallowing are weakened. Some children with cerebral palsy may be completely unable to swallow or may find it difficult to swallow liquids, foods or saliva. ● Medicines – drugs such as metaclopramide may help gastrointestinal motility and improve swallowing. ●Oromotor exercises – Speech therapists will evaluate and plan an exercise program to facilitate swallowing.

Temporomandibular Disorders

Temporomandibular disorder (TMD) is a group of conditions affecting the temporomandibular joint (TMJ), the muscles of mastication, and the associated anatomical structures. Temporomandibular management strategies are focused on reduction/elimination of pain, improvement of function, and ultimately of the patient's quality of life. Conservative approaches include:

1. Patient education and behavioral management—such as modifying habits, training in relaxation and conscious avoidance of excessive jaw movements,
2. Physical therapy—such as muscle exercise regimens, application of transcutaneous electrical nerve stimulation, massage, thermo-/coolant therapy and iontophoresis.
3. Therapeutic medication—nonsteroidal anti-inflammatories, muscle relaxants, and anxiolytics.
4. Occlusal splints, which reduce parafunctional habits due to occlusion alteration, providing orthopedic stability of the TMJ.

Traumatic Dental Injuries

The accentuated risk factors associated with traumatic dental injuries in children with CP include frequent falls, collisions, seizures, tooth grinding, overjet, and a lack of lip seal. The treatment of traumatized teeth and the prevention of future trauma should be of primary importance. A pedodontist should educate the parents, teachers, and caregivers in correct emergency care of CP patients after traumatic injury, to search for preventive measures, such as the use of mouth guards and safe transport of these individuals in wheelchairs. The dentist should emphasize the caregivers that traumas require immediate specialized attention and explain the procedures to follow if a permanent tooth is knocked out. Instructions should be given to the caregivers to find any missing pieces of a fractured tooth.

Dental Caries

Increased prevalence of dental caries is seen in patients with cerebral palsy.[19,20]The common risk factors for these increased prevalence includes mouth breathing, sialorrhea, effects of medication, enamel hypoplasia, food pouching and inability to maintain proper oral hygiene. Caution patients or their caregivers about medicines that reduce saliva or contain sugar. Suggest that patients drink water often, take sugar-free medicines when available, and rinse with water after taking any medicine. Advise caregivers to offer alternatives to cariogenic foods and beverages as incentives or rewards. For people who pouch food, talk to caregivers about inspecting the mouth after each meal or dose of medicine. Remove food or medicine from the mouth by rinsing with water, sweeping the mouth with a finger wrapped in gauze, or using a disposable foam applicator swab. Recommend preventive measures such as

fluorides and sealants, silver diamineflouride and calcium phosphopeptide amorphous calcium phosphate (CCP-ACP).

Periodontal Disease

Periodontal disease is common in people with cerebral palsy due to poor oral hygiene and complications of oral habits, physical abilities, and malocclusion. Another factor is the gingival hyperplasia caused by medications. Involve the patient in hands-on demonstrations of brushing and flossing. Talk to caregivers about daily oral hygiene. A power toothbrush or a floss holder can simplify oral care. Emphasize that a consistent approach to oral hygiene is important. Explain that some patients benefit from the daily use of an antimicrobial agent such as chlorhexidine. Recommend an appropriate delivery method based on your patient's abilities. Rinsing, for example, may not work for a patient with swallowing difficulties or one who cannot expectorate. In such cases, Chlorhexidine applied using a spray bottle or toothbrush can be equally efficacious.

Conclusion:-

Cerebral palsy is the most common physical disability in children and so there is increase interest in CP and its search for better possible treatments has been on the rise. Knowing the possible causes and risk factors for CP can help to diagnose this disorder, as well as possible associated disorders, at an earlier age.

Children with CP have a considerably higher prevalence of oral diseases as compared to otherwise healthy childrens due to lack of oral health education, exposure to treatment, and prevention measures such as fluoride supplements and dental sealants. The oral health of children with CP has always been found poor when compared to otherwise healthy children. The establishment of dental care for these individuals presents a unique challenge. As it is rightly said " Oral health is the mirror to General health" , therefore the role of a dentist is enormous. Dentists dealing with them should possess thorough knowledge of the unusual medical and orofacial abnormalities and their implications in order to formulate safe and effective dental preventive and treatment plans.

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