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Clinical Approach to PEDIATRIC NEUROLOGY

For Postgraduate Students & Practicing Pediatricians



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2nd Edition

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CHAPTER 24

A Case of Cerebral Palsy

HISTORY TAKING

This chapter helps in bedside case presentation of a child with cerebral palsy. Cerebral palsy is static encephalopathy, and the most frequent presenting complaint is developmental delay. Symptoms usually start from the birth, although parents often notice the delay late. If the child has faltered in development after initial normal development, this suggests neuroregression and should be dealt with in a different manner.

The presenting complaints of "developmental delay from birth" are followed by the history of presenting illness. The history of presenting illness will thus start from the antenatal period followed by birth history, developmental history, and history of comorbidities. This is followed by immunization history, nutritional history, family history, and socioeconomic history.

Presenting Complaints

It will be good to keep the following points in your mind while framing presenting complaints:

- Number of presenting complaints can be 2–3 (avoid more than 4 presenting complaints).
- They must be in a chronological order of appearance.
- Avoid the use of medical terminology as far as possible.

Children with cerebral palsy usually have 3–4 presenting complaints.

First complaint is often *developmental delay,* which can be expressed as:

- Delayed attainment of developmental milestones
- Nonattainment of developmental milestones since beginning
- Inability to sit and speak till now
- Inability to sit and speak as per his/her age

Second complaint could be related to *motor weakness or tone abnormalities,* which can be expressed as:

- Tightness of both lower limb and upper limb noticed since 8 months of age
- Abnormal twisting postures of upper limb and lower limb noticed since 9 months of age
- Paucity of movement of right upper and lower limbs noticed since 1 year of age

Third complaint could be one of *comorbidities* such as seizure, vision loss, hearing impairment, recurrent chest infections, and inability to gain weight. The following complaints could be framed to depict positive comorbidities present:

- Multiple episodes of convulsions/fits since 3 months of age
- Three episodes of convulsion in the last 2 months with the last episode 2 days back
- Inability to focus with eyes noticed since 3 months of age

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- Poor visual regard noticed since 3 months of age
- Poor response to sound or hearing impairment noticed since 3 months of age
- Multiple episodes of fever, cough, and fast breathing lasting for 5–6 days over the last 2 years
- Poor weight gain since the beginning

Fourth complaint could be an *acute presentation* for which the child has been brought to medical attention such as fever, cough, loose stools, vomiting, or convulsion. It is not essential to form only these presenting complaints; it will obviously depend upon case to case. **Table 1** outlines a few common clinical scenarios and model presenting complaints.

History of Presenting Illness

Start the history with antenatal history, as the presenting complaints are often from the beginning of life in a child with cerebral palsy.

TABLE 1: Complaints in different type 1 cerebral palsy (CP).

Clinical situation	***Presenting complaints***
Spastic diplegic cerebral palsy	• Inability to walk properly till now • Tightness of both legs with crossing of legs while walking
Spastic quadriplegic cerebral palsy	• Inability to sit or speak till now (or delay in attainment of developmental milestones) • Tightness noticed across the lower limb and upper limbs since the age of 4 months • Three episodes of convulsions over last 2 months
Dyskinetic cerebral palsy	• Inability to sit or speak till now • Abnormal twisting postures of both hands and legs with arching of back noticed since 8 months of age • Cough and fever for 3 days

Antenatal History

Brief and relevant antenatal history about the case of cerebral palsy must include maternal age, whether the conception was spontaneous/in vitro fertilization, previous abortions/stillbirths, ultrasonography scan for fetal malformation and monitoring of fetal growth, regular antenatal visits, and vaccination (tetanus). Besides, detailed individual trimester-wise history (rationale in bracket) should be elicited:

- *T1 (first trimester):* Bleeding per vaginum (threatened abortion), leaking per vaginum (chorioamnionitis), drug history (especially antiepileptic or antipsychotic drugs like fetal valproate syndrome), smoking, radiation, alcohol exposure (fetal alcohol syndrome), fever with rash and swelling in neck/axilla [TORCH (toxoplasmosis, others—syphilis and hepatitis B, rubella, cytomegalovirus, herpes simplex) infection], excessive vomiting, burning micturition [maternal urinary tract infection (UTI) is an independent risk factor for cerebral palsy].
- *T2 (second trimester):* Time at which fetal movements were perceived (excessive fetal movements may indicate intrauterine seizure as seen in nonketotic hyperglycinemia; paucity of fetal movement may indicate fetal onset of hypotonia as in spinal muscular atrophy or congenital myopathy and congenital muscular dystrophy), paleness of body or excessive lethargy, history of headache or raised blood pressure records or deranged blood sugar records during antenatal visit [maternal anemia, pregnancy-induced hypertension (PIH), and gestational diabetes are risk factors for asphyxia].
- *T3 (third trimester):* Bleeding per vaginum, premature rupture of membranes, maternal fever (chorioamnionitis),

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burning micturition (UTI), time taken to delivery (prolonged labor predisposes to asphyxia), need for medication for labor induction/instrumentation (indicator of intrauterine asphyxia), and any precipitous labor (prone to intraventricular bleeds)

Birth History

History of mode of delivery, birth weight, whether the baby cried immediately at birth, need for resuscitation, history of neonatal encephalopathy, neonatal seizures, and neonatal jaundice must be elicited. History of neonatal intensive care admission—need for mechanical ventilation, need for inotropic support, history of phototherapy or exchange transfusion for neonatal jaundice, duration of neonatal intensive care unit (NICU) stay, and need for nasogastric feeds must also be recorded.

Neonatal encephalopathy, neonatal seizures, hypoglycemic insult, intraventricular bleed, preterm brain injury, neonatal jaundice requiring exchange transfusion, and prolonged ventilation (hypoxic injury) are some of the most common causes of neonatal brain injury. It is essential to screen for these adverse neonatal events. Remember that delayed cry at birth is not equivalent to birth asphyxia. It is important to elicit history of neonatal encephalopathy following delayed cry at birth, which may be considered a significant clinical brain injury.

Clinical Status at the Time of Neonatal Discharge

At the time of discharge, ask whether the baby was accepting direct breastfeeds well, was having adequate weight gain, was alert and active, or remained dull/lethargic. This gives us an idea about the degree of encephalopathy or neurological deficit at the time of discharge. For instance, if the baby was dull, lethargic with a paucity of limb movement, and had difficulty in feeding, it is more likely that the baby had signs of encephalopathy.

Developmental History

Developmental history becomes the history of presenting illness, as the presenting complaint is delayed attainment of milestones. Developmental history may be presented in a chronological manner (age-wise) as per the developmental milestone attained across each domain. This is in contrast to a separate heading of developmental history wherein we present the developmental history in the domain-wise manner. Presenting the history should be in a chronological manner.

Example: The baby attained social smile by 3 months. By the age of 6 months, he could hold his neck and could open the hands. By 9 months, he could recognize parents and start cooing. At the present age of 12 months, the child can turn from prone to a supine position, tries to reach for objects, smiles at the mirror image, and has started babbling. These developmental milestones are suggestive of global developmental delay with an approximate developmental age of 5–6 months in the gross motor sphere, 4–5 months in the fine motor sphere, 6–7 months in the cognitive sphere, and 4–5 months in the language sphere against a chronological age of 12 months.

In the cognitive and social domains, it is essential to elicit a history of self-care, learning, communication, acceptance in society, and participation in domestic life. This evolves from the concept of impairment, activity limitation, and participation restrictions as per the international classification of functioning, disability, and health of the World Health Organization (WHO).

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History of Early Signs of Cerebral Palsy

There is no separate heading called "early signs of cerebral palsy" while presenting the history, but early markers of cerebral palsy must be identified in history. This can be presented along with the chronological age of its appearance while presenting the above developmental history, as these complaints again form a part of presenting illness **(Practical Box 1)**. The following early signs may be elicited:

- Lack of alertness and interest in surrounding (a sign of encephalopathy)
- Excessive irritability and poor quality of sleep (a sign of encephalopathy)
- Reduced spontaneous limb movement or asymmetry of limb movement (a sign of encephalopathy)
- Constant fisting of hands (a sign of encephalopathy)
- Early handedness (an early sign of hemiplegic cerebral palsy)
- Small growth of head or small head (indicates poor growth of the brain)

Microcephaly or small head at birth should always be enquired. This often indicates intrauterine or antenatal insult such as TORCH infection and congenital malformation. This must be differentiated from acquired microcephaly, which often results from perinatal brain insult. Head circumference at birth will be useful in this regard, if parents were informed about the same. Hence, every small head size at birth is not a result of perinatal asphyxia. Static intrauterine insults, such as TORCH infection or congenital malformation, are also an important cause of cerebral palsy.

PRACTICAL BOX 1: An example of history of presenting illness.

During the initial 6 months, the baby had lack of alertness and was not responsive to sound. He remained lethargic and had paucity of spontaneous limb movements. By the age of 6 months, he had developed neck holding. His hands were constantly fisted till almost 12 months of age; now he opens his hands intermittently but does not hold the object held in his hand

History of Comorbidities

Salient comorbidities that need to be screened include vision, hearing, feeding difficulty, excessive drooling of saliva, recurrent vomiting, recurrent chest infection, constipation, perception of sensation, seizures, or abnormal body movement **(Table 2)**.

History of Motor Deficits

Motor deficits constitute the most important aspect of cerebral palsy history. History of motor deficits enables us to classify the type of cerebral palsy as hemiplegic, diplegic, spastic, quadriplegic, and dyskinetic **(Table 3)**.

Description of Gait (History)

In ambulatory children with a cerebral palsy, description of gait becomes an important part of history as well as examination. From the gait description, it needs to be clear what type of cerebral palsy we are dealing with. Few examples of description of gait in the history are given in **Practical Boxes 2 and 3**.

Description of Speech (History)

Speech can be described briefly in one line while describing the language milestones in the history of presenting illness among those who are able to communicate with a good vocabulary. It is essential to differentiate between spastic and extrapyramidal dysarthria. Children with isolated spastic dysarthria might have strained quality of

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TABLE 2: Eliciting history of comorbidities.

Comorbidity	***Salient points in history***
Vision	Ability to fix on object, ability to follow or track objects and persons appropriately, and any evident jerky movements of eyes or any obvious deviation of eyes
Hearing	Ability to respond to name, turning to sound, and excessive startles to sound
Feeding	Difficulty in swallowing both solids and liquids (*pseudobulbar effect*), keeps them in mouth for long periods then spitting it (*oropharyngeal incoordination*), persistent drooling of saliva, abnormal tongue thrusting movement (*choreoathetoid movement of tongue*), abnormal chewing/grimacing/pouting or lip smacking movement (*oromotor dyskinesia*)
Bowel habits	Any history of constipation or passage of hard stools or straining at stool
Seizures	History of episodes of vacant stare (*dialeptic seizures*), jerky movement of limbs (*clonic seizures*), abnormal tight posturing followed by jerky movement of limbs (*generalized tonic-clonic seizure*), forced turning of face/head (*focal seizure*), sudden shock-like jerk of body (*myoclonus*)
Sleep	Difficulty in sleep onset, sleep duration in hours, and frequent daytime naps
Behavior	Aggressive, stubborn, temper tantrum, disruptive behavior

TABLE 3: Salient points in history of motor deficits.

Salient points in history	***This indicates***
Early handedness and paucity of movement of one side of the body	Hemiplegia
Tightness noticed across hips while changing the nappies *(hip adductor spasticity)*, scissoring of legs on attempt to make him stand *(hip adductor spasticity)*, on attempt to sit he/she sits with his legs crossed under his/her thighs resembling an English letter "W", on attempt to crawl he/she drags his/her body, as if crawling by soldier commando *(commando crawl)*	Diplegia
Tightness noticed across both upper limb and lower limb joints	Quadriplegia
Fixed contractures/deformities across joints	Contractures/deformity
Abnormal twisting movements of hands while reaching for an object, abnormal arching of the back or abnormal twisting postures of lower limbs on an attempt to bear weight/walk	Dystonia
Abnormal slow writhing movement (*athetosis*), abnormal flowing, bizarre movement (*chorea*), or violent flinging movement (*ballismus*)	Choreoathetoid movement

PRACTICAL BOX 2: An example of description of hemiplegic gait.

While walking, he holds his right arm tightly glued to his body with decreased swing of the right upper limb. At the same time, he drags the right foot and scrapes the toes swinging the right lower limb in semicircular fashion (this description favors right hemiplegic gait)

PRACTICAL BOX 3: An example of description of diplegic gait.

While walking, he keeps the lower limb in such a manner that knees cross in front of each other with each step with hips being held close together. He takes short and narrow steps dragging both the legs and scraping the toes against the floor. It often appears as if feet are stuck to the floor (this description favors scissoring or diplegic gait)

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voice and appear as if they are speaking from their stomach with poor clarity of speech. This speech is often associated with excessive drooling of saliva with a child keeping his tongue protruded. Extrapyramidal dysarthria will have poor clarity of speech and slurred, irregular, and jerky speech with a poor articulation of words. The rest of the detailed speech description can be provided in the examination at the time of the higher mental function (HMF).

Etiological History

The majority of etiological history is already covered in antenatal and birth history. Further, metabolic disorders that can present in this manner should be ruled out. History of abnormal urinary odor, episodes of excessive lethargy (*inborn errors of metabolism*), fluctuations, or worsening with febrile illness (*mitochondrial/organic acidemia*) must be elicited. Any history of postnatal brain injury in the form of head trauma and meningitis (fever, seizure, and altered sensorium) may be useful.

Treatment History

History of investigations including neuroimaging and electroencephalography, if performed, must be described. The nature of supportive treatment including physiotherapy, use of night splints/braces, and occupational and speech therapy, if any, may be mentioned. Any medications for tightness (spasticity/dystonia) and seizures can be mentioned in this history. The name of medications can be mentioned, if parents are able to recollect their name or else it may be mentioned that "*child is receiving drugs for control of seizure, nature of which is not known*". Since history starts from the beginning, the conventional title of "past history" may not be applicable in this case. Hence, include all relevant medical and surgical illnesses in the history of presenting illness.

Other Conventional Pediatric History

Other history includes immunization history, nutritional history, family history, and socioeconomic history. Three-generation pedigree must be made. History of consanguinity, sibling loss, and family history of similar illness or any other neurological or systemic illness must be elicited. Depending on the gender of affected sibling and presence or absence of consanguinity, the mode of inheritance such as autosomal-recessive or X-linked recessive must be suggested.

Summary of History

Example

A 3-year-old boy, a product of nonconsanguineous marriage, presented with complaints suggestive of global developmental delay with a developmental age of 5–7 months in all the domains. The mother complained of tightness involving all the four limbs along with associated feeding difficulties and excessive drooling of saliva. The child has intact vision, intact hearing, no seizures, no history suggestive of extrapyramidal movement disorders, and no fixed deformities or contractures. There is no significant family history, and nutritional history reveals a calorie deficit of 400 kcal/day. The child belongs to a nuclear family with lower middle socioeconomic status.

The probable etiology of this illness could be perinatal asphyxia, neonatal seizures, and prolonged neonatal mechanical ventilation.

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Other differentials/etiological possibilities include:

- Perinatal insult secondary to intrauterine TORCH infection
- Neurometabolic disorders including organic acidemia, mitochondrial disorders, urea cycle defects, and peroxisomal disorders
- Structural malformation of central nervous system (CNS) such as schizencephaly, lissencephaly, and polymicrogyria

Thinking about Differential Diagnoses at the End of History Taking

It is a good idea to keep broad differentials and set up points for and against each differential diagnosis kept. In the case discussed above, the etiologies that could be considered are given in **Table 4**.

FOCUSED EXAMINATION

The sequence of presenting examination findings includes opening remark, vital signs, anthropometry, general physical examination (GPE), developmental examination, and CNS examination. Kindly refer to "*Clinical Methods in Pediatrics by Piyush Gupta*" for detailed methods of examination.

However, salient points in each part of these examinations are summarized here:

- *Opening remark:* This reflects the findings that are obvious even before you touch the child. It is considered as "first look findings". It is desirable to comment on the posture, alertness, overall built, and nutrition and if any medical gadgets (IV cannula and nasogastric tube) attached **(Practical Box 4)**.
- *Vital signs:* These signs will include temperature, heart rate, respiratory rate,

TABLE 4: Differentials and points for and against each differential diagnosis.

Differential diagnosis	*Points for (+)*	*Points against (–)*
Perinatal asphyxia	• History of asphyxia • History of neonatal seizure • History of neonatal encephalopathy	
	• Global developmental delay (GDD) from beginning • *Static insult:* Slowly gaining developmental milestones • Spastic quadriparesis	
TORCH infection	• GDD from beginning • Static insult slowly gaining • Spastic quadriparesis (±)	No history of antenatal fever/rash
Neurometabolic disorder	• GDD from beginning • Static insult slowly gaining • Spastic quadriparesis (±)	• No consanguinity (A-R) • No sibling loss (A-R) • No history suggestive of metabolic error such as the abnormal smell of urine • No fluctuations in illness
Structural malformation	• GDD from beginning • Static insult slowly gaining • Spastic quadriparesis (±)	No seizures (±)

Note: ± means that this point may favor or disfavor this differential.
(A-R: autosomal recessive)

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PRACTICAL BOX 4: An example of description of opening remark.

Child is sitting comfortably in mother's lap; he is alert, smiling, and showing reasonable interest in surroundings with evident tight posturing of both upper and lower limbs with intermittent twisting postures of hands. He is of average built and nutrition. He has IV cannula secured in his right hand

PRACTICAL BOX 5: Vital sign description.

- *Temperature:* 99°F right axilla as measured for 3 minutes
- *Heart rate:* 80 beats/min and pulse is regular, rhythmic, synchronous, all peripheral pulses palpable
- *Respiratory rate:* 26 breaths/min, regular, and abdominothoracic
- *Blood pressure:* 90/62 mm Hg as measured in right arm supine position
- Capillary refill time is <3 seconds

blood pressure, capillary refill time, and SpO_2, if applicable. Most of these children are often admitted for respiratory tract infection **(Practical Box 5)**.

- *Anthropometry:* Children with cerebral palsy are prone to malnutrition secondary to feeding difficulties, gastroesophageal reflux disease, and recurrent chest infections. Detailed anthropometric measurements and interpretations including weight, length, head circumference, and mid-arm circumference are required.

  In children with spastic quadriplegia, exact length measurement might be difficult owing to fixed contractures or deformities; the same may be acknowledged during the case presentation.
- *GPE:* Conventional head-to-toe GPE with emphasis on the following parameters is expected:
  - Signs of malnutrition, anemia, and vitamin deficiency
  - *Head shape:* Presence of overriding sutures, craniosynostosis, and abnormal skull shape must be commented.
  - *Any evidence of neurocutaneous markers* such as café-au-lait macules, port-wine stain, ash-leaf macules, and axillary fold freckling
  - Any obvious *bony deformities* such as scoliosis and kyphosis must be commented.
  - Any evidence of *hip subluxation* can be commented (spastic diplegic children are prone to hip subluxation). Although it is mentioned under musculoskeletal examination, it can be mentioned in GPE as well.
- *Developmental examination:* The focus of developmental examination in a child with cerebral palsy is to confirm the findings of developmental history. At the end of the developmental examination, we can conclude that "*developmental examination findings corroborate with a developmental age of 5–6 months as elicited by history in all domains*". Detailed developmental examination as per the age can be read from "*Clinical Methods by Piyush Gupta, 4th edition*". It is obvious that only relevant examination as per developmental and chronological age will be performed and this will be decided on a case-to-case basis. *Primitive reflexes* including the presence of asymmetric tonic neck reflex, palmar grasp, and Moro reflex can be described as a part of the developmental examination.

  The developmental examination is described under the headings of gross motor domain, fine motor skills, cognition, and adaptive skills **(Practical Boxes 6 and 7)**.

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PRACTICAL BOX 6: Description of developmental examination.

A 3-year-old boy with global developmental delay with spastic quadriplegia and history revealing overall developmental age of 5–6 months

Gross motor:

- *Pull to sit:* Head control was complete
- *Prone positioning:* He could lift his head and chest off the couch and elbow extended
- *Vertical suspension:* Intermittent scissoring of legs was noticed
- *Supine position:* He could turn from prone to side position
- Overall gross motor age is 16–20 weeks

Fine motor skills: He could reach for the cubes but could not transfer from one hand to the other. Grasp of the cubes was immature and was masked by dystonic posturing of hands (fine motor age 4–5 months)

Cognitive: He turned to mother's voice and looked at mother when asked to point at her, he gets excited when mother reaches for him, and he looks eagerly at the toys offered to him but is afraid to hold them

Language: He was observed to babble but did not speak any meaningful monosyllables (4–5 months)

Overall development of the child is 4–5 months as against a chronological age of 36 months

PRACTICAL BOX 7: Presenting developmental examination of a 6-year-old child with spastic diplegia.

- *Gross motor:* He can walk, run, and climb stairs with one foot per step while going up, but uses two per step while coming down (4–5 years)
- *Fine motor skills:* He can draw hexagon, build bridge using cubes, and draw three parts in draw-a-man test
- *Cognition:* He could do simple verbal additions, but cannot do subtraction, can count 1–25; he could identify all colors; he can differentiate small and big size; in the picture book, he can point to more than five objects and name up to four objects
- *Language:* He can narrate a rhyme with normal fluency and articulation with no evidence of dysarthria during his spontaneous conversation

Impression: Gross motor age 4–5 years against expected 7 years; the rest of milestones are age appropriate and correspond to developmental age assessed as per history

- *Gross motor skills* will include maneuvers like pull to sit, ventral suspension, vertical suspension, prone positioning, ability to sit independently, ability to stand from sitting position, ability to stand and walk independently, and so on. Among those who are ambulatory, gait needs to be described in the motor examination.
- *Fine motor skills* will be tested using rattle, red ring, cubes, pencils/crayons, picture cards, colors, thread beads, simple form boards, and draw-a-man test.
- *Cognition:* Few of cognitive assessment that can be done bedside includes mature pointing, looking for hidden toy, pointing to body parts, pointing to named object/person, identifying shapes, colors, size, concept of numbers, answering questions from the story, counting 1–10, telling days of week, doing simple arithmetic calculation, and so on.
- *Speech:* Correlate the history of speech milestones with the observation of spontaneous speech.

- At this stage, one can mention the persistence of *primitive reflexes* including asymmetric tonic neck reflex, palmar grasp, crossed extensor, and Moro reflex. Many examiners prefer primitive reflexes as a part of reflexes in motor system examination.

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- *CNS examination:*
  - *HMFs:* Most of the HMFs cannot be assessed objectively in children with cerebral palsy. It is a good idea to comment on appearance, behavior, consciousness, and speech **(Practical Box 8)**. Other components of HMF including orientation, attention span, abstract thinking, memory, insight, perception, calculation, and fund of information are difficult to assess in these children. Components of language assessment include fluency, articulation, comprehension, reading, writing, repetition, and naming. Also, we may comment on content, volume, and the pitch of speech. Refer to **Chapter 1** on clinical neuroanatomy to understand the components of speech and types of dysarthria.
  - *Cranial nerves:* Focus of cranial nerve examination is to comment on visual acuity (presence of visual fixation and following), fundus (to look for evidence of chorioretinitis and optic atrophy), deviation of eyes (paralytic squint/concomitant squint), nystagmoid eye movement, hearing response, and integrity of oropharyngeal coordination (drooling of saliva, poor gag reflex, oromandibular dystonia, oromotor dyskinesia, tongue-thrusting movement, difficulty in sucking/swallowing, and tonic bite reflex) **(Practical Box 9)**.

PRACTICAL BOX 8: Description of speech of a 7-year-old child with dyskinetic cerebral palsy.

On assessment of spontaneous conversation, there is reduced clarity of speech with poor articulation of words with constant drooling of saliva. There is a marked restriction of speech output. The child prefers gestural communication to indicate for his needs. The content of speech is appropriate, as his mother can understand what he wishes to convey. Comprehension of verbal commands, naming, and repetition is preserved. However, reading and writing could not be assessed in this child. This speech could indicate extrapyramidal dysarthria

PRACTICAL BOX 9: Cranial nerve (CN) description of a 7-year-old child with dyskinetic cerebral palsy.

- *First CN:* Could not be tested
- *Second CN:* Visual fixation and following are preserved. However, formal visual acuity could not be performed. Color vision and field of vision could not be tested. Fundus reveals primary optic atrophy
- *Third/fourth/sixth CN:* There is right eye esotropia evident on primary gaze; conjugate eye movements are preserved in all cardinal plane; and saccadic eye movements are preserved with no evidence of oculomotor apraxia. Pupils are normal size and reactive to direct light reflex. Accommodation reflex could not be tested. There are no evident nystagmoid movements
- *Fifth CN:* Jaw movements are preserved, but there is evidence of difficulty in opening the jaw owing to oromandibular dystonia. The sensory component of 5th CN could not be commented
- *Seventh CN:* Facial symmetry is preserved. Other parts of 7th CN examination including taste sensation in anterior two-thirds and testing for tear production were not tested
- *Eighth CN:* He could localize to whisper and respond appropriately
- *Ninth/tenth CN:* There was difficulty in opening the mouth. There was constant drooling of saliva and difficulty in deglutition. However, I could not observe the movements of soft palate and uvula, nor was he cooperative for gag reflex testing
- *Eleventh CN:* Could not be tested
- *Twelfth CN:* He intermittently protrudes the tongue with drooling of saliva. Individual tongue movements could not be tested. There are no obvious tongue fasciculations

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PRACTICAL BOX 10: Description of posture and gait.

A 3-year-old child with spastic quadriplegic cerebral palsy (CP): Posture: Child is lying supine with both upper limbs flexed at elbow, and wrist joint with pronation of forearm. The lower limbs are extended at hip, knee, and ankle joint with intermittent arching of the back

A 6-year-old child with spastic diplegia:
Gait: He walks with short steps, keeping his both thighs tight close to each other, dragging each foot with narrow base and scraping the floor with his toes with normal arm swing. While he is walking, it seems as if both his feet are sticking to the floor. There is no difficulty in initiation of gait; he could stop abruptly when asked to do so and can negotiate turn on either side (to rule out parkinsonian features)

- *Motor system examination:* Components of motor system examination include gait/posture, bulk of muscle, tone of muscle, power of muscle, deep tendon reflexes (DTRs), superficial reflexes, and abnormal movement and coordination. Posture is described among those children who are nonambulatory and gait is described among the ambulatory children **(Practical Box 10)**.

Details of patterns of *gait* described in cerebral palsy including scissoring gait, jump gait, equines gait, crouch gait, and stiff knee gait can be read from standard textbooks.

Tone assessment is the most crucial step in the examination of children with cerebral palsy. It is essential to look for evidence of spasticity and rigidity and differentiate them from dystonia. This helps in classifying the type of cerebral palsy. One should also comment on evidence of contractures or spasticity in a specific group of muscles.

- *Upper limb:* Flexors, adductor, and internal rotators are the most commonly affected.
- *Lower limb:* Hip flexor (crouched), knee flexor (flexed knee), hip adductors (scissoring), and knee are internally rotated and gastrocnemius (on the toe).

The most common mistake that happens during the case presentation is to differentiate spasticity from rigidity and dystonia. Dystonia is a movement disorder and not a tone abnormality **(Table 5)**.

Contractures, if any, should be commented on dynamic or fixed contractures. Any obvious deformities must not be missed. These include kyphoscoliosis; hip subluxation and dislocation; equinus, varus, and valgus deformity; and femur internal and external torsion. It will be good to grade tone across the individual joints as per modified Ashworth grading of tone **(Table 6)**. Other methods including Tardieu scales are also acceptable.

In children less than 2 years, angles (adductor angle, ankle dorsiflexion angle, and popliteal angle) may be measured using a goniometer and mentioned under tone assessment while describing the motor system examination and compared with age norms **(Table 7)**.

- *Power examination:* Most of the formal power testing will be difficult in children with cerebral palsy owing to limited cooperation and muscle contractures. But a rough functional assessment of upper limb muscles including the maturity of grasp and release will be useful. Power must be tested across individual joints, and a rough estimate of assessment must be made. If the child is able to move across the joint against gravity, the power is "*at least 3/5*" across that joint for that particular movement. It is often not possible to test all movements across the joints, and this must be acknowledged while presenting the case. Functional assessment is more

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TABLE 5: Differences between spasticity, dystonia, and rigidity.

Features	*Spasticity*	*Dystonia*	*Rigidity*
Important feature	Velocity-dependent resistance	Sustained abnormal twisting posture	Independent of speed or posture
Increase speed of passive movement	Resistance increases	No effect	No effect
Presence of fixed postures	No	Yes	No
Effect of emotions	No	Yes	No
Direction	Unidirectional	Bidirectional	Bidirectional
Upper motor neuron signs (brisk reflexes and extensor plantar)	Present	Absent	Absent

TABLE 6: Modified Ashworth grading of tone.

Grade	*Feature*
Grade 0	No increase in tone
Grade 1	Slight increase in tone with a catch or minimal resistance at the end of range
Grade 2	Minimal resistance through the range but with catch
Grade 3	More marked increase tone through ROM (range of motion)
Grade 4	Considerable increase in tone, passive movement difficult
Grade 5	Affected part is rigid

TABLE 7: Angles for assessment of tone.

Age (months)	*Adductor angle (°)*	*Popliteal angle (°)*	*Ankle dorsiflexion (°)*	*Scarf sign*
0–3	40–80	80–100	60–70	Elbow does not cross midline
4–6	70–110	90–120	60–70	Elbow crosses midline
7–9	110–140	110–160	60–70	Elbow goes beyond axillary line
10–12	140–160	150–170	60–70	–

important in children with cerebral palsy than individual movements.

Gross motor function classification system (GMFCS):

- Walks without restrictions
- Walks without assistive devices but limitations in community
- Walks with assistive devices
- Transported or uses powered mobility
- Severely limited dependent on wheelchair

Manual ability classification system (MACS) (4–18 years) for upper limb function:

- Handles objects easily and successfully
- Handles most of objects but decreased quality and speed
- Handles objects with difficulty, needs help to prepare or modify activity
- Handles limited selection of easily managed objects in adapted situation
- Does not handle object at all and inability to perform simple action

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TABLE 8: Description of movement disorder in children.

Movement disorder	*Description (keywords are marked in italics)*
Athetosis	Slow, *distal, writhing*, continuous, and involuntary movements. They are commonly associated with chorea (choreoathetosis)
Ballismus	Involuntary, *high-amplitude,* and *flinging* movements that typically occur proximally
Chorea	Involuntary, *semipurposive, bizarre,* and *chaotic* movement
Dystonia	Dystonia is a syndrome of sustained muscle contractions, frequently causing abnormal twisting and repetitive movements, or abnormal postures
Myoclonus	Quick, very brief, involuntary, and nonsuppressible shock-like movements of one or more muscles
Parkinsonism	*Presence of two or more of the cardinal features of Parkinson's disease:* Tremor at rest, bradykinesia, rigidity, and postural instability
Stereotypies	Involuntary, patterned, coordinated, repetitive, nonreflexive movements that occur in the same fashion with each repetition
Tics	Sudden, rapid, abrupt, repetitive, and nonrhythmic movement
Tremors	Oscillating and rhythmic movements about a fixed point, axis, or plane that occur when antagonist muscles contract alternately

Power assessment is followed by an examination of DTRs, superficial reflex, and assessment of abnormal movement including choreoathetosis, dystonia, and ballismus **(Table 8)**. Coordination testing is often limited owing to limited cooperation, and the same can be acknowledged. Brisk DTR is an indicator of pyramidal tract involvement. DTR is difficult to elicit among those with generalized dystonia.

Other Neurological Examination

- *Sensory system examination:* The majority of sensory system examinations cannot be performed among children with cerebral palsy unless cognition is relatively preserved.
- *Cerebellar signs:* It is again difficult to elicit individual cerebellar signs among these children. In the presence of choreoathetosis and dystonia, cerebellar signs should not be overinterpreted.
- Meningeal signs may be difficult to elicit.
- *Skull and spine examination* with a focus on skull shape, craniosynostosis, and evidence of raised intracranial pressure (McEwan sign).

Musculoskeletal Examination

The focus of musculoskeletal examination includes joint range of motion (ROM) (slow and smooth), deformity including dynamic deformity (only on posture such as standing), contractures, balance, posture, sitting, and gait **(Table 9)**.

SUMMARY OF CASE (TEMPLATE)

A 3-year-old boy, product of nonconsanguineous marriage with no significant family history, presented with:

- Global developmental delay (developmental age of 5–6 months against 3 years of age)

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TABLE 9: Musculoskeletal examination.

Examination	*Focus of examination*
Back	Scoliosis and kyphosis
Hip	Femoral anteversion, hip flexion, hip adductor contracture, and hip subluxation
Knee	High-riding patella, posterior capsular tightness, and popliteal angle
Ankle	Varus/valgus deformity, leg length discrepancy, and gastrocnemius/soleus contracture
Sitting balance	Free sitting/hand-dependent sitting/propped sitter

- Mixed signs of spasticity (Ashworth grade 4) and dystonia
- Fixed contractures involving bilateral ankle joint and dynamic hip adductor contracture
- GMFCS (level 2), MACS (level 3)
- Preserved vision, hearing, and right esotropia
- Feeding difficulties secondary to oromandibular dystonia and oromotor dyskinesia
- Excessive drooling of saliva
- No epilepsy/seizures
- Wasting and no stunting by the WHO classification
- Presence of anemia

Possible etiological differentials:

- Perinatal asphyxia
- Structural malformation of CNS
- Perinatal TORCH sequelae
- Neurometabolic disorders such as phenylketonuria and organic acidemia

KEY MESSAGES

- Bedside case presentation of a child with cerebral palsy may start from the antenatal period, natal period, and postnatal period followed by the history of early signs of cerebral palsy.
- Developmental history is a part of history of presenting illness and may be presented as per the chronological age rather than presenting domain-wise.
- History of comorbidities including vision, hearing, seizures, contractures, feeding difficulties, constipation, and recurrent chest infections must always be elicited.
- Domain-wise developmental examination, measurement of angles (in infants), the examination of primitive reflexes, and advanced postural reactions are additional examinations that must not be missed during case presentation of cerebral palsy.
- The summary of the case must always mention the functional status in terms of GMFC and MACS.

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