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**Research Article**

# MRI EVALUATION OF BRAIN IN PAEDIATRIC PATIENTS PRESENTING WITH DEVELOPMENTAL DELAY

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**A R T I C L E I N F O**

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**A B S T R A C T**

Development is a complex and continuous process of maturity, parallel to the growth of children, which can affect many aspects, and begins from conception and continues until maturity.[1] Children who cannot gain/acquire appropriate developmental skills at the expected age have been considered suffering from developmental delay.[2] Developmental delay (DD), defined as the delay in meeting developmental milestones at the expected age, is a frequently encountered problem in pediatric neurology.[3] Neuroimaging may detect abnormalities in up to 50% of children with neurodevelopmental disability, with a variable detection rate dependent on factors such as selection criteria and imaging method used.So our aim of this study is to identify the prevalence of abnormalities of the brain in children with developmental delay on MRI and further categorize the morphological abnormalities.



## INTRODUCTION

Development is a complex and continuous process, parallel to the growth of children, and begins from conception.[1] During the development, a child can establish a variety of relations with the surrounding environment. The rate of development varies from a child to another and depends on various factors. Developmental delay (DD), defined as the delay in meeting developmental milestones at the expected age, is a frequently encountered problem in pediatric neurology.[2] The precise prevalence of DD among infants and the children is still unknown but has been estimated to be 1% to 3%.[3] Global DD (GDD), a subset of developmental disabilities, is defined as a significant delay in 2 or more of the following developmental domains: gross/fine motor, speech/ language, cognition, social/personal, and activities of daily living.[4] Cognitive and motor development observed in infants and children are a reflection of postnatal brain development. Any delay in neurodevelopment is likely to have a biological correlate.[5] Careful evaluation and investigation can reveal a cause in up to 85% cases with developmental delay. Causes for global developmental delay are genetic or syndromic, metabolic, endocrine, traumatic, environmental causes, cerebral malformations, cerebral palsy and developmental motor coordination disorders, infections, toxins etc Establishing a cause has many benefits for the child and family and improves the overall quality of life.[6]

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Various investigations can be used to assess children with delayed milestones. Neuroimaging often proves useful in detecting major or minor malformations of the brain that may suggest a specific cause for a particular child's DD. Brain ultrasonography (USG) has a main role in the detection and management of neonatal disease in the preterm as well as term infant. It is a noninvasive, radiationfree, and reproducible procedure that can be performed at bedside, in the intensive care unit, and on the intubated ventilated baby.[7] USG has also proven very useful for the detection of intracerebral hemorrhage and for detecting hypoxic-ischemic changes. But it has some limitations of being operator dependent and is not used once the fontanelles close.

Computed tomography (CT) is performed in the infant when USG does not satisfy the clinical question or when an acoustic window is not available. CT also aids in detecting acute or subacute processes such as intracranial hemorrhage, cerebral edema, hypoxic-ischemic injury, infarction, hydrocephalus/shunt dysfunction, neoplasm, or abnormal collections. When implemented with 3-dimensional reconstruction algorithms, CT effectively evaluates cranial or facial abnormalities such as in craniosynostosis and hemifacial microsomia. Computed tomography is also useful in detecting intracranial calcifications present in entities such as TS, TORCH infection, and craniopharyngioma.[2] But it has the major drawback of using harmful radiation.

Magnetic resonance imaging (MRI) is considered the modality of choice for the evaluation of the brain at all ages. MRI provides great anatomical detail, has high sensitivity and

specificity in detecting brain pathologic findings. Therefore, it is the imaging modality of choice for the infant or child with DD. Among its vast capabilities, MRI is incredibly useful in defining complex central nervous system (CNS) anomalies such as disorders of dorsal induction (eg, Chiari II malformation, cephaloceles) or ventral induction (eg, holoprosencephaly). MRI also provides excellent contrast between gray and white matter, allowing the detection of disorders of cortical development.[8] It can differentiate myelinated from unmyelinated white matter in the infant[9], and it offers the highest sensitivity in detecting acute anoxic injury of the brain.[10]

The present study was aimed to perform MRI evaluation of brain of pediatric patients presenting with delayed milestones to Department of Radiodiagnosis at Dr. R.P.G.M.C Kangra at Tanda, Himachal Pradesh.

## MATERIAL AND METHODS

A prospective cross-sectional observational study conducted in the Department of Radiodiagnosis at Dr. R.P.G.M.C Tanda, Himachal Pradesh, India during one year period, 70 cases were studied. All Consecutive children aged up to 16 years with developmental delay referred from the department of Paediatrics for MRI evaluation were included in the study. MRI of the brain performed on 1.5 Tesla MRI scanner. Sequences used were: Axial T1 FSE, Axial T2 PROP, Axial T2 FLAIR, Axial DWI, Axial 3D FSPGR, Coronal T2 FSE, Sagittal T1 FSE.

### *Statistical Analysis*

Data were presented as frequency and percentages. Chi-square test with Yates correction was used to measure difference categorical variables between two groups. A P value <0.05 was considered significant. Statistical analysis was performed using SPSS trial version 21.

## RESULTS

The present study was aimed to identify the prevalence of abnormalities of the brain in children with developmental delay on MRI and further categorize the morphological abnormalities. This prospective study was conducted on patients referred with history and clinical examination suggestive of delayed milestones to the Department of Radiodiagnosis for MRI at Dr. RPGMC Kangra at Tanda, Himachal Pradesh. A total of 70 patients were enrolled into the study. The study results are below:

**Table 1**. Age and Sex (n=70)

| Age and Sex | | Total patients (n=70) |
|---|---|---|
| Age-group (Years) | <1 | 19 (27.14%) |
| | 1-5 | 42 (60%) |
| | 6-10 | 6 (8.57%) |
| | 11-16 | 3 (4.28%) |
| Sex | Male | 48 (68.5%) |
| | Female | 22 (31.5%) |

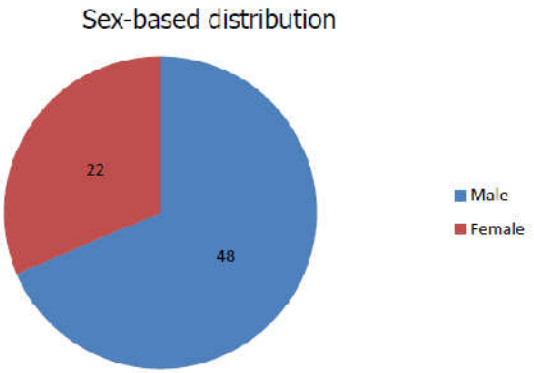



**Table 2** Brain MRI Examination

| MRI findings | | Patients (n=70) |
|---|---|---|
| Normal | | 39 (55.71%) |
| Abnormal (n=31; 44.29%) | Neurovascular Disease | 16 (22.85%) |
| | Congenital and Developmental Disease | 5 (7.14%) |
| | Metabolic Disease | 2 (2.85%) |
| | Non-specific | 8 (11.43%%) |

**Table 3** MRI- examination based distribution of age and sex among patients (n=70)

| Distribution of Age and Sex | | Patients (n=70) | |
|---|---|---|---|
| | | Normal (n=39) | Abnormal (n=31) |
| Age-group (Years) | <1 (n=19) | 9 (23.07%) | 10 (32.25%) |
| | 1-5 (n=42) | 25 (64.10%) | 17 (54.8%) |
| | 6-10 (n=6) | 4 (10.05%) | 2 (6.45%) |
| | 11-16 (n=3) | 1 (2.56%) | 2 (6.45%) |
| Sex | Male (n=48) | 26(66.67%) | 22 (70.96%) |
| | Female (n=22) | 13 (33.33%) | 9 (29.04%) |

**Table 4** seizures

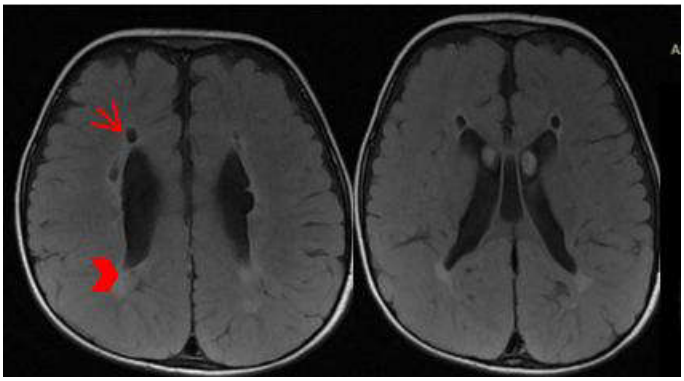
| Seizures | Normal MRI (n=39) | Abnormal MRI (n=31) | P Value |
|---|---|---|---|
| Present (n=14) | 3 (7.69%) | 11 (35.49%) | P=0.0097 |
| Absent (n=36) | 36 (92.31%) | 20 (64.51%) | |

**Table 5** Patameters Developmental Delay

| Parameters of Developmental Delay | | Normal MRI (n=39) | Abnormal MRI (n=31) | P Value |
|---|---|---|---|---|
| Gross Motor | Normal (n=30) | 26 (66.67%) | 4 (12.9%) | P=0.000 |
| | Delayed (n=40) | 13 (33.33%) | 27 (87.1%) | |
| Fine Motor | Normal (n=34) | 28 (71.79%) | 6 (19.35%) | P=0.000 |
| | Delayed (n=36) | 11 (28.21%) | 25 (80.65%) | |
| Social and Adaptive | Normal (n=32) | 26 (66.67%) | 6 (19.35%) | P=0.000 |
| | Delayed (n=38) | 13 (33.33%) | 25 (80.65%) | |
| Language | Normal (n=29) | 24 (61.54%) | 5 (16.13%) | P=0.000 |
| | Delayed (n=41) | 15 (38.46%) | 26 (83.87%) | |

**Table 6.**Affected anatomical structures

| Affected Areas | Abnormal (n=31) |
|---|---|
| Grey Matter | 4 (12.9%) |
| White Matter | 20 (64.52%) |
| Basal Ganglia | 2 (6.45%) |
| Thalami | 1 (3.23%) |
| Ventricles | 14 (45.16%) |
| Corpus Callosum | 12 (38.71%) |
| Cerebellum | 2 (6.45%) |



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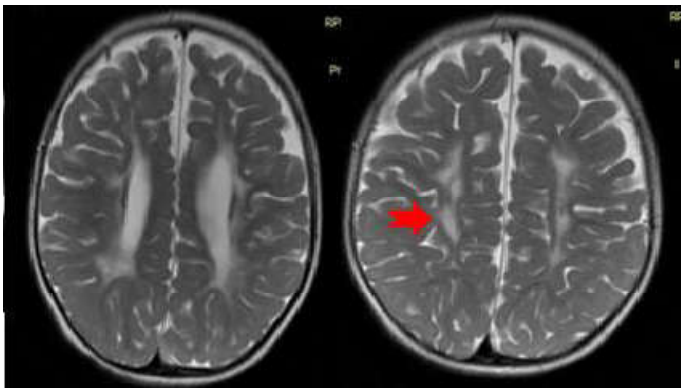
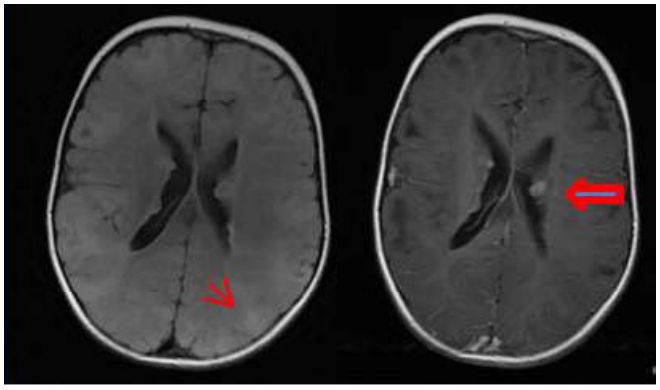


B

**Fig 1** Spectrum of findings in two patients of HIE- (A) showing enlarged, scalloped b/l ventricles with White matter volume loss with periventricular hyperintensities (arrowhead) and cyst formation (arrow) (B) white matter hyperintensities.(notched arrow).



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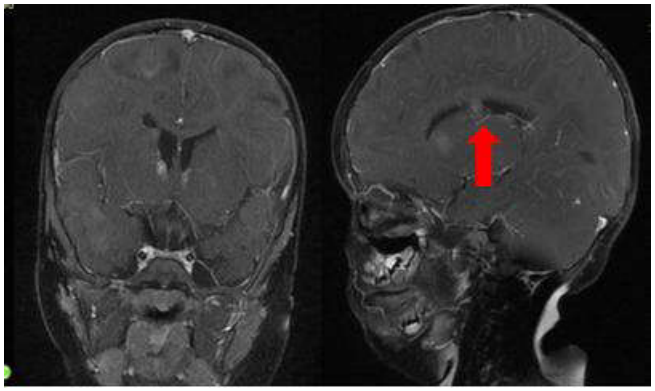


B

**Fig 2** Tuberous Sclerosis- Multiple cortical tubers (thin arrow) and subependymal nodules showing enhancement (Thick arrows).

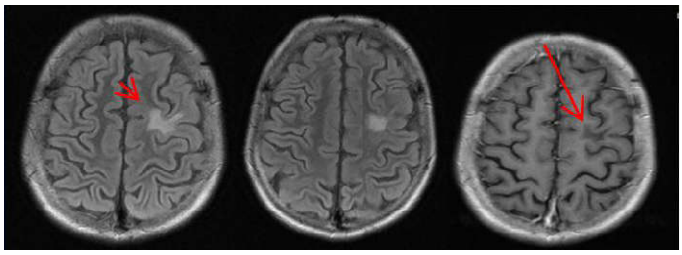
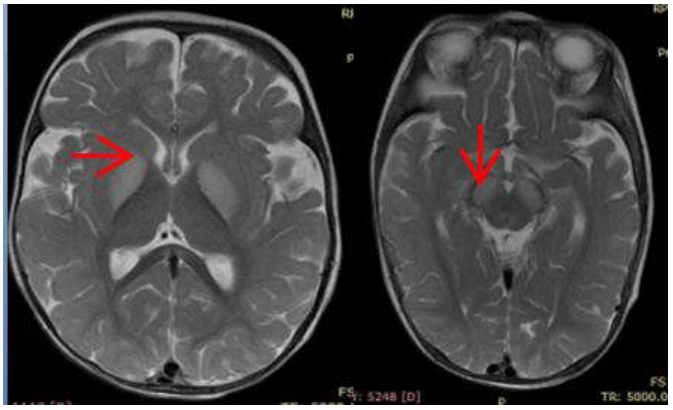


**Fig 3** Focal Cortical Dysplasia-T2 Flair gyralhyperintensity (short arrow) ,hypointense on T1(long arrow) in left frontal lobe with gyral broadening.



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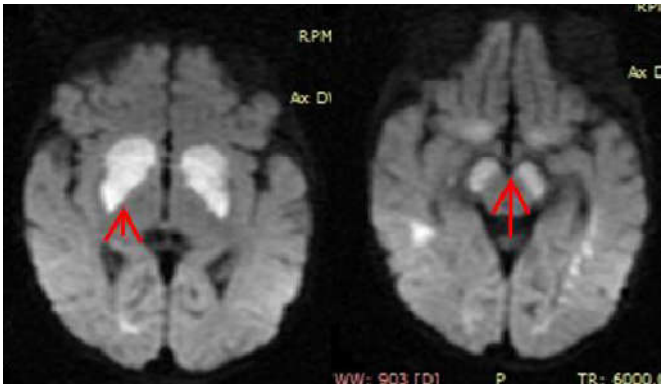
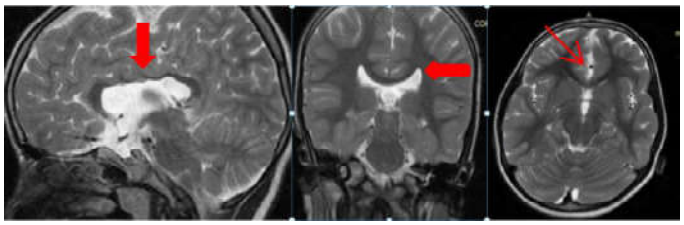
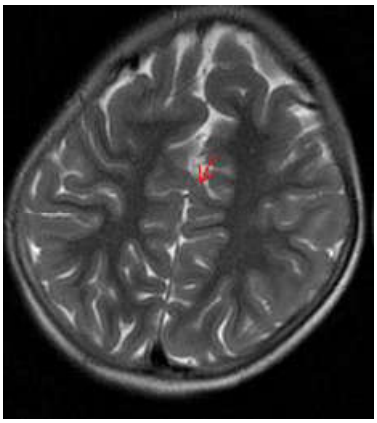



B

**Fig 4** Symmetrical T2 and T2 FLAIR hyperintensities in b/lglobuspallidi, putamina, cruscerebri with diffusion restriction (arrows). MRS shows decreased NAA and increased lipid lactate.



**A**



**B**

**Fig 5** First image shows corpus callosum agenesis involving body,Second image shows absent septum pellucidum and monoventricle. Third image shows azygous ACA. Fourth image shows fused dorsal mid hemispheric cortex high frontal lobe.

## CONCLUSION

Developmental delay presents with a wide spectrum of etiologies, clinical findings and MRI features ranging from completely normal to abnormal. The present study could establish various morphological appearances of developmental delay on MRI. Most commonly affected age group was <1 year of age. 20% of affected patients had a seizure disorder and 14 % had a history of NNJ (Neonatal jaundice). White matter was mostcommonly affected among all the anatomical structures and the most common caus was found to be neurovascular disease in which all cases of HIE were included.

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