

# MRI Evaluation of Brain in Children with Developmental Delay

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## ABSTRACT

**Introduction:** Developmental delay is termed as gross or significant delay in more than one developmental domains. They are associated with a wide range of etiologies including genetic, metabolic, endocrine, vascular, malformation syndromes, traumatic, infections, toxins and environmental causes. Study aimed to observe the efficacy of MRI Brain in children with developmental delay.

**Material and methods:** An observational and descriptive study of MRI of the Brain in 50 patients who were referred by the Pediatric department for a duration of six months from May 2016 to October 2016.

**Results:** Abnormal morphological appearance was seen in the remaining 42 patients like Prominent Virchow-Robin spaces and abnormal basal ganglia seen in 5 cases, Hypoxic Ischemic Encephalopathy (HIE) in 8 cases, congenital and developmental anomalies in 13 cases. Cerebral atrophy with encephalomalacic changes was seen in 6 cases while hypoplasia of the corpus callosum and ventriculomegaly were also seen in 10 cases.

**Conclusion:** MRI of Brain will help us in showing association of brain anomalies with etiologies of developmental delays and the positive outcome of neuroimaging.

**Keywords:** Developmental delay, MRI brain, Pediatric patients

## INTRODUCTION

Developmental delay is not a disease nor a diagnosis but it is a symptom or clinical presentation.<sup>1-4</sup> The diagnosis of developmental delay is not immediately done after birth, but done during infancy or early childhood. Many times the diagnosis is done one the child enters the school.<sup>5,6</sup> The definition of developmental delay is termed as significant delay in one or more developmental domains.<sup>2</sup> The diagnosis significantly impedes quality life of the patient and full participation in the life of the family, school and community. In such cases it depends on the clinician's ability to detect and diagnose the cause with a multimodality approach which always includes neuroimaging. There are wide range of etiologies which include genetic, metabolic, endocrine, vascular, malformation syndromes, traumatic, infections, toxins and environmental causes.<sup>1,3</sup> In some causes we may find that clinical findings can lead us to the diagnosis but in most of the cases MRI Brain is necessary to get actual picture of the abnormality leading us towards the accurate diagnosis which further helps the clinician in properly treating the patient. This study aimed to characterize structural anomalies of the brain in mental retardation and the relationship between them and the degree of mental retardation. Aims and objectives of the study were to know the efficacy of MRI Brain in patients presenting with symptoms of developmental delay and the prevalence of normal and abnormal MRI in pediatric patients presenting with developmental delay and further categorize the abnormal MRI based on its morphological features.

## MATERIAL AND METHODS

Ethical clearance was obtained from MGM University ethical committee. Permission to conduct the study at MGM Radiology Department was obtained from MGM authorities.

An observational and descriptive study of MRI of the Brain in 50 patients was done who were referred by the Pediatric department for a duration of six months from May 2016 to October 2016. The patients were diagnosed for developmental delay after taking detailed history. Both sexes were included in the study. It was a duration based study. MRI study of brain was conducted after sedating the child or making the child sleep. The sequences used were: Axial T1TSE, Axial T2TSE, Axial T2 FLAIR, Axial EP2D diffusion, Axial T2TIRM, Axial PDTSE, Coronal T1TIR, Coronal T2TSE, and Sagittal T1TSE.

### Inclusion Criteria

The patients who had developmental delay, aged between 2 months and 12 years, admitted for the first time to diagnose the cause of delay.

### Exclusion Criteria

- 1) The patients with known causes like Down syndrome, Turners Syndrome, Metabolic Disorders like Rickets and Scurvy, Protein Energy Malnutrition, Infections like Tonsillitis, Pneumonia or any other Communicable disease in active stage were excluded.
- 2) The patients who had undergone MRI study of Brain previously.

After conducting MRI of the brain, the images were evaluated and the following structures were systematically evaluated following to Widjaja et al., protocol.<sup>5,6</sup>

1. Ventricles: Size and morphology.
2. Corpus callosum: Thickness and morphology.
3. Gray and white matter: The sulcation and gyration of the gray matter based on normal MR brain anatomy.
4. Basal ganglia: morphology.
5. Brain stem: morphology.
6. Cerebellum: morphology. The term cerebellar atrophy was used if the cerebellum was small with shrunken folia and large cerebellar fissures or if it had been shown to undergo progressive volume loss. A structure was considered dysplastic if disorganized in development, such as abnormal folial pattern or presence of heterotopic nodules of gray matter.

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Assignment of anomalies: The MRI findings were divided into five groups.<sup>7</sup>

1. Normal.
2. Traumatic/Neurovascular Diseases.
3. Congenital and Developmental disorders.
4. Metabolic and neurodegenerative diseases.
5. Neoplastic diseases.
6. Nonspecific findings – includes ventriculomegaly, enlarged subarachnoid spaces and delayed myelination, etc.

### STATISTICAL ANALYSIS

Descriptive statistics like mean and percentages were used to interpret the data. Microsoft office 2007 was used for the statistical analysis.

### RESULTS

Normal MRI brain findings were seen in 8 of pediatric patients presenting with developmental delay. These children were advised further evaluation to diagnose the etiology of developmental delay. Out of all the patients 30 were males while 20 were female patients. Abnormal morphological appearance was seen in the remaining 42 patients. Nonspecific abnormalities

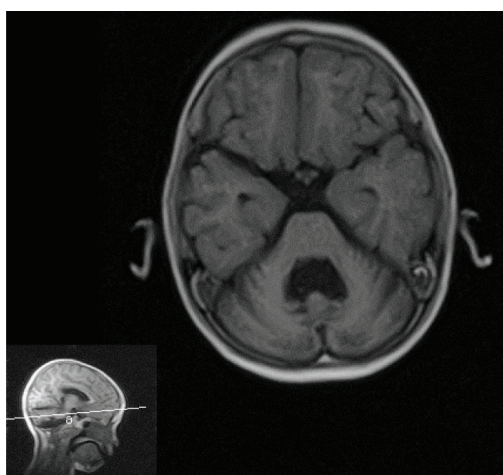
were found like Prominent Virchow-Robin spaces and abnormal basal ganglia seen in 5 cases. The most common abnormality encountered in present study was Traumatic / Neurovascular Diseases like Hypoxic Ischemic Encephalopathy (HIE) in 8 cases. The Congenital and developmental abnormalities of the brain found in 13 cases had following syndrome complexes: dandy walker malformation, hemisphere hypoplasia (Figure-1), dandy walker variant (Figure-2,3), holoprocencephaly, open and closed lip schizencephaly (Figure-4). Cerebral atrophy with encephalomalacic changes (Figure-5) was seen in 6 cases. Hypoplasia of the corpus callosum and ventriculomegaly were also seen in 10 cases.

### DISCUSSION

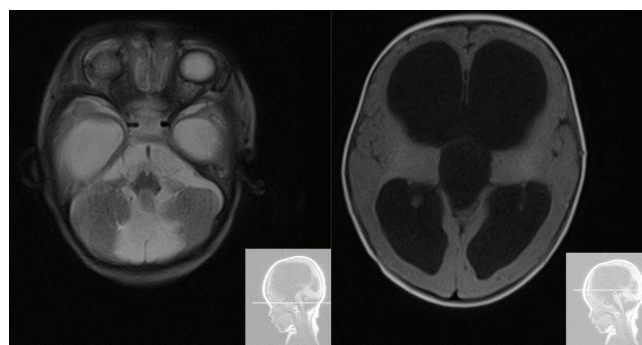
In India, sources have found prevalence of 1.5-2.5% of developmental delay in children under 2 years of age.<sup>10,11</sup> These impairments impact not only the child and the family, but also the society, in terms of the cost of providing health care, educational support, and treatment services.<sup>12</sup> Evidence supports that early treatment of developmental disorders leads to improved outcomes for children and reduced costs to society.<sup>12-14</sup>

After evaluating the MRI findings, we segregated the features and divided them into various etiologies as described above.

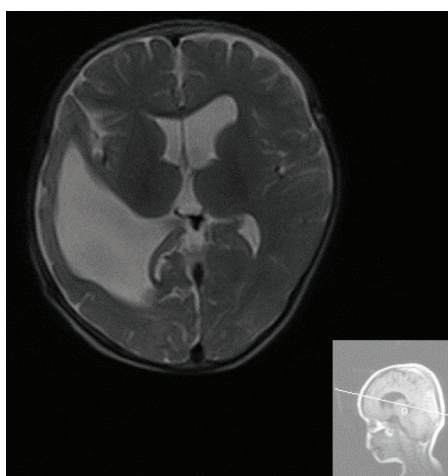
Out of all the patients 8 patients showed normal MRI brain



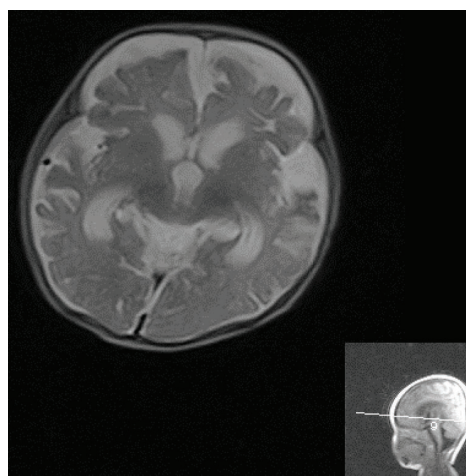
**Figure-1:** On Axial T1 weighted images there is prominence of cerebellar folia with dilatation of central ventricle suggestive of severe cerebellar hemisphere hypoplasia.



**Figure-2 and 3:** On Coronal T1 and Axial T1 and T2 weighted images there dysplastic cerebellar vermis, dilated ventricular system and thinning of cortex of cerebral hemispheres. Posterior fossa appears normal suggestive of Dandy Walker Variant



**Figure-4:** On Axial T2 weighted images a grey matter lined CSF cleft is noted extending from atrium of right ventricle to the subarachnoid space suggestive of Closed lip schizencephaly.



**Figure-5:** On T2 weighted images there is cerebral atrophy with encephalomalacic changes noted in bilateral frontal and bilateral parietal lobe.

findings. A study done in Korea between 1993–1991 on 34 children with developmental delay showed 76.5% patients had abnormal findings on brain MRI while 23.5% patients had normal MRI brain.<sup>16</sup>

Next there were 8 patients with Traumatic/ Neurovascular Diseases (Hypoxic Ischemic Brain Injury) ranked the highest followed by Congenital and Developmental Anomalies. The patients who presented with congenital and developmental anomalies had distinct radiological findings. Patients who presented with congenital and developmental anomalies were associated with religious belief when proper history was taken. A study done by Momen et al., reported that in their study there was slightly higher incidence which could be explained by the religious beliefs that these patients follow, of not terminating the pregnancy in antenatally diagnosed abnormality.<sup>1</sup>

In our study abnormalities of corpus callosum and ventricles were seen in 10 patients while in another study done by Widjaja et al., who studied 90 such children and found that Ventricles and Corpus Callosum were the most commonly involved structures, while the other structures.<sup>5</sup>

MR imaging is an important part of the comprehensive evaluation of children with developmental delay, as many specific aetiologic and pathophysiologic conditions that lead to developmental delay can be detected easily.<sup>8,9</sup>

Males were higher in number than females. Similar age of presentation and sex incidence was noted in the study performed by Momen et al.<sup>1</sup>

Unfortunately we did not receive patients with neoplasms, white matter degeneration and metabolic diseases.

In our study 5 patients had nonspecific findings like Prominent Virchow-Robin spaces and abnormal basal ganglia similar to a study by Althaf S. Ali et al., which had 3 cases with nonspecific findings.<sup>15</sup>

## CONCLUSION

MRI evaluation of brain contributes to the process of diagnosis of etiologies of developmental delay. Developmental delay has wide spectrum of etiology ranging from normal to abnormal. MRI study of brain helps the clinician in proper diagnosis leading to appropriate treatment and parent counselling. The chance of increasing the yield of diagnosis increases with not only MRI brain but further imaging advances like Functional MRI, MR Spectroscopy, Diffusion Tensor Imaging and Tractography especially in structurally normal brain of these children.

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