# Original Article

# MRI in Characterization of Congenital and Developmental Anomalies of Spine

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Received: 01-06-2018

Accepted: 25-01-2019

## Abstract:

**Background:** The incidence of NTDs is also relatively high in Indian and Eastern Mediterranean populations. The care of these patients requires evaluation and attention to primary lesion and also to the affected systems outside the nervous system, at present and during the life long follow up many of these patients require.

**Objective:** The purpose of study was to evaluate the role of magnetic resonance imaging (MRI) in characterizing the congenital and developmental disorders of spine.

**Methods:** Total 70 patients with clinically suspected spinal dysraphism were included in the study. All the patients were made to undergo MRI spine using GE 1.5 Tesla MRI after taking informed consent for the same. The findings of MRI spine were assessed and analyzed.

**Results:** There is female predominance, female to male ratio being 36:24. The peak occurrence of congenital spinal lesions is seen in age group 0-20 years (70%) and more common is females than males (36:24). Spina bifida is commonly associated with tethered cord (66.7%) followed by Syrinx (56.7%), Diastematomyelia (36.7%) and thick filum terminale (20%).

**Conclusion:** Magnetic resonance imaging (MRI) is an accurate & noninvasive modality for characterizing and diagnosing these disorders of spine. It was also found that magnetic resonance imaging is superior in defining these lesions, which is a big advantage over other imaging modalities.

**Key words:** Magnetic resonance imaging, spine, meningocele, spinal dysraphism

## Introduction:

Congenital and developmental disorders of spine are due to the defects of the neural tube. These defects involve the imperfect development of the neuropore during the embryogenesis and the subsequent mal-development of the adjacent bone and mesenchymal structures. The incidence of spinal dysraphism is 1-2 cases per 1000 live births. [1, 2] An open neural tube defect (ONTD) is the most common major birth defect. The incidence rates of ONTD vary widely, not only among countries but also among regions within countries. Rates are significantly higher in areas of low socioeconomic status. The incidence of NTDs is also relatively high in Indian and Eastern Mediterranean populations. [3]

Thus, the care of these patients requires evaluation and attention to primary lesion and also to the affected systems outside the nervous system, at present and during the life long follow up many of these patients require.

Magnetic resonance imaging (MRI) is superior in defining these lesions, which is a big advantage over other imaging modalities. Spinal lesions are increasingly being diagnosed due to advent of newer imaging modalities like MRI; therefore MRI is of diagnostic usefulness in patients with congenital spinal lesions. The purpose of study was to evaluate the role of magnetic resonance imaging (MRI) in characterizing the congenital and developmental disorders of spine.

## METHODS:

**Study Design:** The cross sectional descriptive study.

**Samplings:** Total 70 patients with clinically suspected spinal dysraphism were included in the study. All the patients were made to undergo MRI spine using GE 1.5 Tesla MRI after taking informed consent for the same. The findings of MRI spine were assessed and analyzed.

**Study Centre:** Department of Radio-Diagnosis, Chalmeda Anand Rao Institute of Medical Sciences, Karimnagar

**Duration:** This study was conducted the period of January 2017 to January 2018.

**Inclusion criteria:**

1. All clinically suspected cases who are advised MRI.

**Exclusion criteria:**

- All post operative cases.
- Claustrophobic patients.
- Patients on pace maker and metallic implants

**Imaging Protocol**

A complete clinical history of patients was taken which included name, age, sex occupation, presenting complaints. This was followed by general physical examination and detailed examination of the spine region.

Imaging was done using an FOV of 300-500, 512 x 512 matrix sizes and 3-4 mm slice thickness. Patients are made to lie supine in the magnet during the procedure. The protocol included sagittal and axial images of cervical, thoracic and lumbar regions.

T1 & T2 weighted sequences in sagittal orientation with a slice thickness of 3 to 4mm was used. The T2-weighted assessment is often referred to as myelography (MR). These sequences can be performed with and without fat saturation, as in selected cases fat suppression is helpful for assessment of intra-spinal fatty lesions (e.g., lipoma).

These sequences are followed by axial acquisitions of the affected area; the angulation of these axial sections should parallel the vertebral discs. Particularly in oncologic disease-intravenous Gadolinium administration with post contrast T1-weighted acquisitions with and without fat saturation in sagittal and axial orientation were used. Coronal images were also beneficial in segmentation disorders with hemi vertebrae or Diastematomyelia.

Multi-planar reconstruction was used for proper depiction of tiny structures such as a very small fistula tract or as encountered in the first year of life.

**Ethics Approval**

This study was approved by the Institute Ethics Committee of Chalmeda Anand Rao Institute of Medical Sciences, Karimnagar. Once the patient agrees to participate in the study, information will be obtained as per the proforma.

## RESULTS:

A total 70 patients (34 males and 36 females) were examined using MRI.

**Table 1: Sex wise distribution in patients with congenital spinal lesions**

| Sex | No. of cases | Percentage |
|---|---|---|
| Males | 34 | 48.6 |
| Female | 36 | 51.4 |
| Total | 70 | 100 |

Table 1 showed that there is female predominance, female to male ratio being 36:24. The peak occurrence of congenital spinal lesions is seen in age group 0-20 years (70%) and more common is females than males (36:24).

**Table No. 2 Distribution of patients based on the level of spine involvement in patients with congenital spinal lesions:**

| Level | No of cases | Percentage |
|---|---|---|
| Cervical | 2 | 6.7 % |
| Thoracic | 6 | 20.0 % |
| Lumbar | 16 | 53.3 % |
| Sacral | 6 | 20.0 % |
| Total | 30 | 100.0 % |

Above table 2 showed, the distribution of congenital spinal lesions is commonest in lumbar region, seen in 53.3% of patients. Cervical region is rarely involved.

**Table 3: Age-wise distribution of spinal curvature abnormalities in patients with congenital spinal lesions**

| Age | No. of cases | Percentage |
|---|---|---|
| Infantile(<3yrs) | 5 | 16.6 |
| Juvenile(3-10yrs) | 8 | 26.7 |
| Adolescent (>10years) | 17 | 56.7 |
| Total | 30 | 100.0 |

**Table 4: Distribution of vertebral anomalies in patients with congenital spinal lesions**

| Vertebral anomalies | No. of cases n=70 | Percentage |
|---|---|---|
| Spina bifida | 32 | 45.7 |
| Block vertebra | 17 | 24.3 |
| Hemi vertebra | 16 | 22.9 |
| Butterfly vertebra | 13 | 18.6 |
| Posterior element dysraphism | 8 | 11.4 |
| Sacral agenesis | 0 | 0 |

Table 4 showed that the spina bifida (45.7%) is commonest vertebral anomaly in patients with congenital spinal lesions. Sacral agenesis is rare vertebral anomaly in patients with congenital spinal lesions.

**Table 5: Disorders associated with tethered cord**

| Associated disorders | No. of Cases (n=30) | Percentage |
|---|---|---|
| Spina Bifida | 20 | 66.7 |
| Syrinx | 17 | 56.7 |
| Diastematomyelia | 11 | 36.7 |
| Thick Filum terminale | 6 | 20.0 |
| DDS | 4 | 13.3 |
| FLp | 4 | 13.3 |
| Lp | 3 | 10.0 |
| MMC | 5 | 16.7 |
| LMMC | 4 | 13.3 |
| MC | 1 | 3.3 |
| Arnold chiari malformation | 3 | 10.0 |

Above table no 5 showed, Spina bifida is commonly associated with tethered cord (66.7%) followed by Syrinx (56.7%), Diastematomyelia (36.7%) and Thick filum terminale (20%).

## DISCUSSION:

Congenital malformations of the spine and spinal cord that most commonly elicit medical examination are represented by spinal dysraphism and caudal spinal anomalies. Although most of these conditions are diagnosed at birth or in early infancy, some may be discovered in older children or even in adults. Because of its multiplanar imaging and tissue characterization capabilities, magnetic resonance imaging (MRI) has greatly ameliorated the diagnosis of these disorders and has enhanced the possibility of earlier and case-tailored treatment.

Spinal dysraphism is believed to be more common in females than in males. The sex difference seems to be consistent in most studies. De Wals P et al study showed that about 55-70% of neural tube defects occur in females. This female predominance was seen in both still and live births. [4]

Another study was conducted by Kemal Sarica et al, where a total of 47 children were enrolled out of which 27 were girls and 20 were boys & male: female ratio was 1.3. [5] The current study also, female predominance is noted and female to male ratio was seen to be 36:34. (Table No 01). The peak occurrence of the spinal dysraphism is seen in the age group: 0-20 years with 70%. (Table 2)

A study conducted by Assaad A and others showed that almost all of the spinal dysraphism with subcutaneous mass occur in the lumbosacral spine. [6] In present study, the commonest location was lumbar region with 53.3%. Cervical region was rarely involved accounting for 6.7%. (Table 4)

These congenital spinal deformities included 29 cases of congenital scoliosis and one case of congenital kyphosis. Nine patients had intraspinal anomalies identified on MRI. In patients with congenital spinal deformity they found 9 (30%) of 30 to have an associated anomaly within the spinal canal. [7] In the present study 42.9% of the spinal dysraphism had spinal curvature abnormality. (Table 5)

In our study showed, all the vertebral anomalies in patients with congenital spinal lesions, spina bifida is the commonest (45.7%), followed by block vertebra (24.3%), hemivertebra (22.9%), butterfly vertebra (18.6%) and posterior element dysraphism (11.4%). None of the cases had sacral agenesis. (Table 7)

The present study shows that the vertebral anomalies are the commonest spinal anomalies in patients with congenital spinal lesions with 77.1%, followed by spina bifida (45.7%), tethered cord (42.9%), scoliosis/ kyphosis (42.9%), syrinx (40%) and Diastematomyelia (22.9%). (Table 8)

Locations of myelomeningoceles of the 30 patients in our study, 2 were noted in the cervical region, 6 in the dorsal region, and 18 in the lumbar region and 5 in the sacral region. Among these lumbar region is the commonest location. In a study by Muhammed Nafees et al, lumbosacral region is the commonest location which constituted 38 (51.4%). In a study by Mohamed Fathy Dawodh et al, lumbosacral region is the commonest location which constituted 11 (73.3%). [8, 9]

MR imaging provided accurate preoperative information in 91 out of 92 cases (98.9%). It is concluded that MRI is an excellent primary diagnostic tool, together with a plain radiograph for complete preoperative evaluation of mid-line spinal anomalies.

## CONCLUSION:

Congenital malformations of the spine cord are collectively called as spinal dysraphism. These conditions are usually diagnosed at birth or in early infancy but some may be discovered in older children or adults. From the present study it was noted that, magnetic resonance imaging (MRI) is an accurate & noninvasive modality for characterizing & diagnosing these disorders of spine. It was also found that Magnetic resonance imaging is superior in defining these lesions, which is a big advantage over other imaging

modalities. MRI has greatly improved the diagnosis of these disorders and enhanced the possibility of earlier and case tailored treatment.

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**Figure 1: Sagittal T2-weighted MR image shows large meningocele (*arrow*) in cervical region**

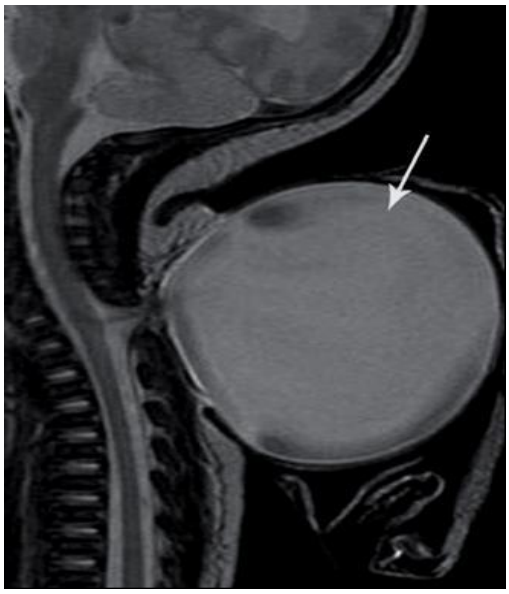
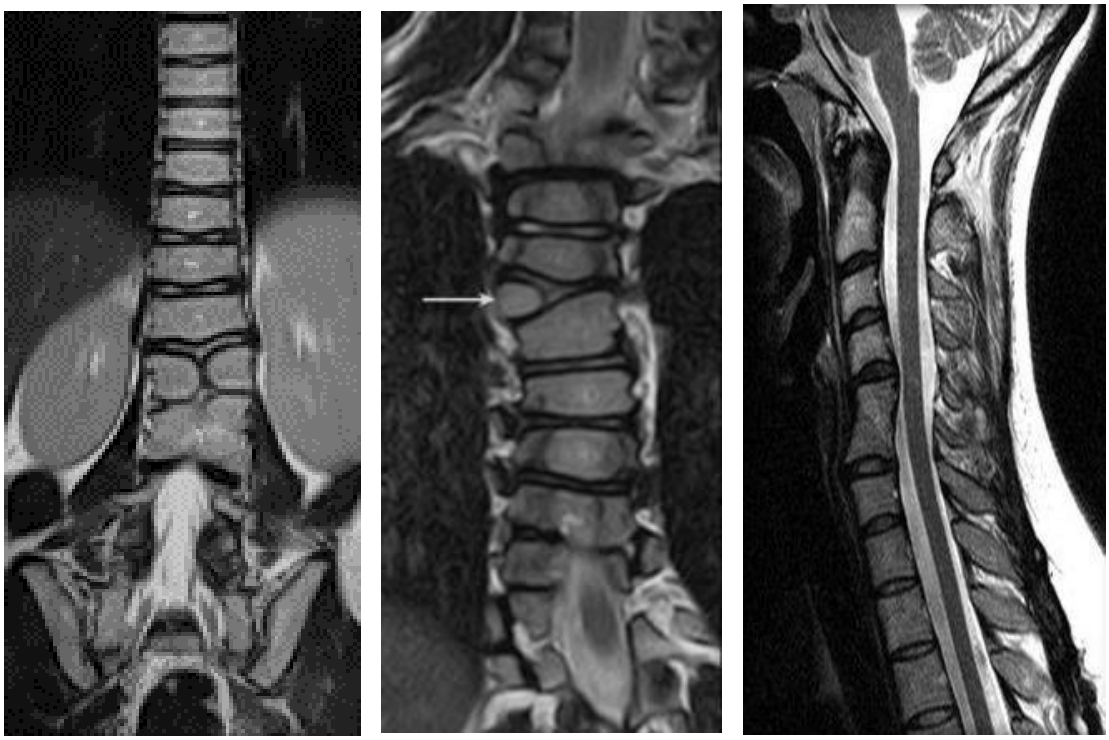


**Figure 2: Coronal T2 weighted images showing butterfly vertebra and hemi vertebra and sagittal T2 weighted image shows block vertebra**



**Source of Support:** Nil. **Conflict of Interest:** None.

Cite this article as: Harshavardhan NS, Ravi Kiran G, Madhurwar AU, Mounika P, Shanmuga Raju MRI in Characterization of Congenital and Developmental Anomalies of Spine. MRIMS J Health Sciences 2019;7(2):31-35.