Original Research Article

Role of magnetic resonance imaging (MRI) in characterizing the congenital and developmental disorders of spine

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Abstract

Background: A wide range of congenital and developmental disorders of spine are due to the defects of the neural tube. Magnetic resonance imaging (MRI) is highly effective for evaluating intraspinal pathology when compared with traditional radiography and invasive radiography. **Aims and Objectives:** To study the role of magnetic resonance imaging (MRI) in characterizing the congenital and developmental disorders of spine. **Materials and Method:** 70 patients with clinically suspected spinal dysraphism were included in the study. All the patients were made to undergo MRI spine using 1.5 Tesla MRI (superconducting magnet, MAGNETOM SYMPHONY) manufactured by SIEMENS after taking informed consent for the same. The findings of MRI spine were assessed and analyzed. **Results:** Vertebral anomalies (77.14%) were the commonest findings on MRI, followed by Spina bifida (45.71%), Tethered cord (42.86%), Scoliosis/ kyphosis (42.86%), Syrinx (40%) and Diastematomyelia (22.86%). Spina bifida (66.67%) was commonly associated with tethered cord, followed by syringohydromyelia, diastematomyelia, thick filum terminale and others. Spina bifida (57.14%) and tethered cord (57.14%) were commonly associated with syringohydromyelia. Diastematomyelia was more prevalent in the age group 0-10 years (43.75%) and in female population (62.5%) with male to female ratio being 1: 1.67. **Conclusion:** Magnetic resonance imaging is an accurate, noninvasive, safe and advanced modality for evaluation of the congenital spinal disorders and help in better management of these patients with prompt and accurate diagnosis with case tailored treatment.

Key Words: spinal dysraphism, Congenital spinal disorders, MRI.

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INTRODUCTION

A wide range of 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. Magnetic resonance imaging (MRI) is highly effective for evaluating intraspinal pathology when compared with traditional radiography and invasive radiography[1,2]. The information from MRI is obtained with less invasiveness and can be very useful in the evaluation of patients with congenital spinal deformity, especially those with intraspinal anomalies requiring adjunctive neurosurgical intervention. Before the introduction of MRI, myelography and computed tomography (CT) were the procedures of choice to detect intraspinal cord anomalies requiring intervention. The incidence of reported anomalies varied from 4.9 to 58% depending on authors and diagnostic techniques. Winter *et al*. noted diastematomyelia in 4.9% of patients with congenital scoliosis. However, this study failed to include other types of spinal deformities[3]. McMaster reported an 18.3% incidence of intraspinal anomalies in patients with congenital spine abnormalities[4]. Blake *et al*. reported 58% incidence of spinal cord abnormalities in 108 cases of congenital scoliosis[5]. The latter studies were based on myelographic findings. MRI is highly effective in identifying early developmental conditions of the neural axis, such as tethered cord and syringomyelia[6]. Iskandar *et al*. reported a significant difference in the incidence of

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identifying intraspinal anomalies in occult spinal dysraphism between the techniques of myelography and MRI[7]. Terminal syrinx was found in 27% of the 90 cases that were evaluated by MRI but in only 6.2% of 48 cases done by myelography and postmyelography CT. This finding suggests MRI's superiority in detecting intraspinal anomalies. MRI, which is noninvasive and has superb contrast resolution, may be an excellent screening technique for lumbosacral dysraphism, as suggested by the findings in various studies. With further application, experience, and technological development, MRI may become a cost-effective method for complete pretherapy evaluation and follow up. Thus the present study was undertaken to study the role of MRI in characterizing the congenital and developmental disorders of spine

MATERIALS AND METHOD

The present observational study was conducted in KLES imaging centre, Belgaum, over a period of one year. The following inclusion and exclusion criteria was used select the study subjects.

Inclusion Criteria

- All clinically suspected cases who are advised MRI.

Exclusion Criteria

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

By using the above mentioned inclusion and exclusion criteria, total 70 cases were registered during the study duration. After obtaining the informed consent from the patients, information was collected on a prestructed proforma. Complete clinical examination was done in all the patients. After this all the patients were subjected to the MRI spine. All examinations (MRI spine) were performed using 1.5 Tesla superconducting magnet, MAGNETOME SYMPHONY, Siemens, software version SYNGO 2002 of Germany, using a Phased array spine coils. The MRI spine findings were recorded on the proforma and were confirmed by senior faculties also to reduce the error in the diagnosis. Data analysis will be done using rates, ratios and percentages of different diagnosis and outcomes made by MRI spine, which will be computed and compiled.

RESULTS

Table 1: Age and Sex wise and age wise distribution in patients with congenital spinal lesions

Age (yrs)	Males		Females		Total No. of cases
	No. of cases	%	No. of cases	%	
0-10	12	35.29	21	58.33	33
11-20	6	17.65	10	27.78	16
21-30	3	8.82	0	0.00	3
31-40	3	8.82	2	5.56	5
41-50	4	11.76	0	0.00	4
> 50	6	17.65	3	8.33	9
Total	**34**	**100.00**	**36**	**100.00**	**70**

It was observed that the peak occurrence of congenital spinal lesions was seen in age group 0-20 yrs (70%) and more common in females than males (1.05:1).

Table 2: Distribution of patients according to spinal anomalies diagnosed by MRI

Spinal anomalies	No. of Cases (n=70)	Percentage
Diastematomyelia	16	22.86
Spina bifida	32	45.71
Tethered cord	30	42.86
Syrinx	28	40.00
Scoliosis	30	42.86
Lipoma	6	8.57
MC	2	2.86
MMC	6	8.57
LMMC	6	8.57
FLp	4	5.71
Dermoid	1	1.43
Teratoma	1	1.43
DDS	4	5.71
NEC	1	1.43
Thick filum terminale	9	12.86
Arnold chiari malformation	8	11.43
Vertebral anomalies	54	77.14

On MRI various disorders were diagnosed in the study subjects. It was observed that vertebral anomalies (77.14%) were the commonest findings on MRI, followed by Spina bifida (45.71%), Tethered cord (42.86%), Scoliosis/ kyphosis (42.86%), Syrinx (40%) and Diastematomyelia (22.86%).

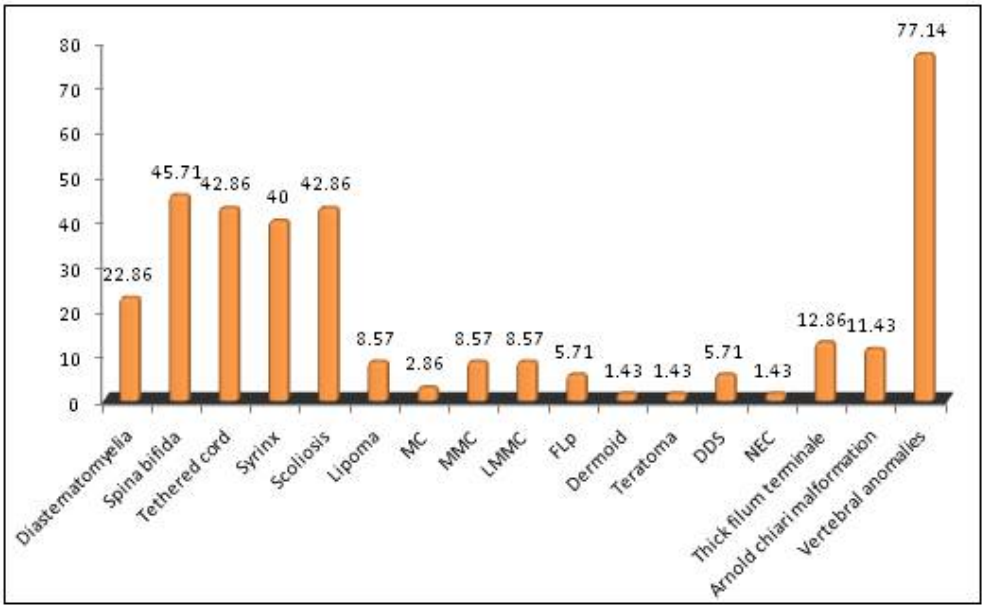


Figure 1: Distribution of patients according to spinal anomalies diagnosed by MRI

Table 3: Disorders associated with tethered cord

Associated disorders	No. of Cases (n=30)	Percentage
Spina Bifida	20	66.67
Syrinx	17	56.67
Diastematomyelia	11	36.67
Thick Filum terminale	6	20.00
DDS	4	13.33
FLp	4	13.33
Lp	3	10.00
MMC	5	16.67
LMMC	4	13.33
MC	1	3.33
Arnold chiari malformation	3	10.00

Tethered cord were was diagnosed in 30 cases in the present study. and it was observed that Spine bifida was the most commonly associated disorder with tethered cord (66.67%), which was followed by Syrinx (56.67%), Diastematomyelia (36.67%) and Thick filum terminale (20%).

Table 4: Disorders associated with syringomyelia

Associated disorders	No. of cases (n=28)	Percentage
Spina bifida	16	57.14
Tethered cord	16	57.14
Diastematomyelia	12	42.86
Abnormal curvature	11	39.29
Arnold chiari malformation	7	25.00
Thick filum terminale	4	14.29
DDS	1	3.57
Lp	2	7.14
FLp	2	7.14
MC	1	3.57
MMC	4	14.29
LMMC	1	3.57

In the present study, Spina bifida and tethered cord were commonly associated with Syrinx (57.14%), followed by Diastematomyelia (42.86%) and Spinal curvature abnormalities (39.29%).

Table 5: Age and sexwise distribution of diastematomyelia in patients with congenital spinal lesions:

Variable		No. of Patients	Percentage
Age	0-10	7	43.75
	11-20	5	31.25
	21-30	1	6.25
	31-40	2	12.50
	41-50	1	6.25
	>50	0	0.00
Sex	Males	6	37.5
	Females	10	62.5
Total		**16**	**100.0**

It was observed that incidence of diastematomyelia was decreasing as the age advances. The peak occurrence of Diastematomyelia is seen in age group of 0-10 years with 43.75%. There was female predominance was observed in the patients of diastematomyelia, with male: female ratio being 1:1.67.

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 syndrome involves a large group of congenital spine and spinal cord anomalies. Despite the fact that they all are heterogeneous, they are accompanied by incomplete consolidation of medially located mesenchymal, osseous, and nervous structures. Spinal dysraphism is believed to be more common in females than in males. The sex difference seems to be consistent in most studies. In a done study by De Wals P *et al*[8] had showed that, about 55-70% of neural tube defects occur in females and this female predominance was seen in both still and live births. In a another study was conducted by Kemal Sarica *et al*[9] also observed female predominance with male:female ratio was 1.3. In present study we also observed female predominance. It was also observed that spinal dysraphism was more common in younger age group with the peak occurrence in the age group of 0-20 years (70%). The study by Kemal Sarica *et al*[9] have shown that, the age range of the children with spinal dysraphism was 2 months to 16 years (mean 6.9 years). During a special roentgenographic survey of the skeletal system in Japanese children by Wataru W *et al*[10] also showed the age distribution as 6 to 7 year.

The present study showed that the vertebral anomalies were the commonest spinal anomalies in patients with congenital spinal lesions with 77.14%, followed by spina bifida (45.71%), tethered cord (42.86%), scoliosis/kyphosis (42.86%), syrinx (40%) and diastematomyelia (22.86%).

It was observed that spina bifida (66.67%) was commonly associated with tethered cord, followed by syringohydromyelia (56.67%), diastematomyelia (36.67%), thick filum terminale (20%), MMC (16.67%), LMMC (13.33%), DDS (13.3%), filar lipoma (13.33%), lipoma (10%), Arnold chiari malformation (10.0%) and MC (3.33%). In a study by Rajpal S *et al*[11] the most common intraoperative findings were LMMC (41%) and tight filum terminal (36%). Another study by Bulent Duz *et al*[12] showed overall tight filum terminal in 21 patients, post-repair MMC in 4 patients, LMMC/MC in 8, split cord malformation in 3, DDS in 7, and syringomyelia in 3 61 patients. In the present study it was observed that spina bifida and tethered cord was commonly associated with syringohydromyelia with 57.14% each, followed by diastematomyelia (42.86%), abnormal spinal curvature (39.29%), Arnold chiari malformation (25%). In a study conducted by Koyanagi I *et al*[13] on clinical and radiological features of syringomyelia in 15 patients observed that 7 patients has spina bifida also. Thus the findings were consistent with the present study. The peak occurrence of diastematomyelia was seen in 0-10 age group (43.75%). It was also observed that there was female predominance (62.5%) in the patients with diastematomyelia with male to female ratio being 1:1.67. In a study conducted by Y. C. Gan *et al*[14] among the patients of diastematomyelia, observed that mean age at time of diagnosis was 3.4 years (range 5 days–12 years) with female predominace. From the present study it was noted that, magnetic resonance imaging (MRI) as an accurate and noninvasive modality for characterizing and diagnosing these disorders of spine. In addition, due to its multiplanar capabilities and superior soft tissue contrast, MRI allows for the better delineation of the spinal cord, the subarachnoid space, the vertebral bodies and the intervertebral discs and can be employed in infants and children without harmful effects. It was also

found that Magnetic resonance imaging is superior in defining these lesions, which is a big advantage over other imaging modalities. Since MRI does not involve ionizing radiation, has no known biological risk, and avoids the intrathecal injection of contrast media, it offers several advantages in the evaluation of children with suspected spinal dysraphism. Spinal lesions are increasingly being diagnosed due to advent of this newer imaging modality MRI, hence this study is undertaken to assess the diagnostic role of MRI in patients with suspected congenital spinal disorders.

CONCLUSION

Magnetic resonance imaging is an accurate, noninvasive, safe and advanced modality for evaluation of the congenital spinal disorders and help in better management of these patients with prompt and accurate diagnosis with case tailored treatment.

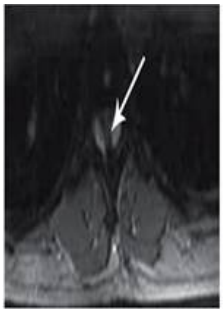
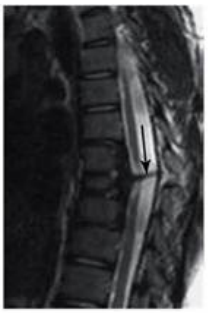


Figure 1



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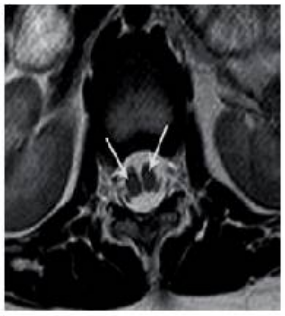

Figure 3

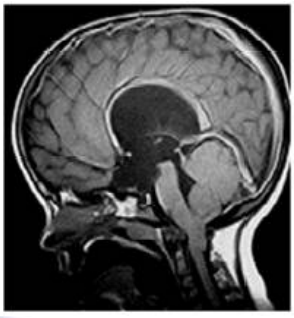

Figure 14

Figure 1: Type I diastematomyelia**; Figure 2:** Type II Diastematomyelia**; Figure 3:** Arnold chiari malformation; **Figure 4:** Vertebral anomalies

Type 1 Diastematomyelia: Axial and Sagittal T2-weighted images show two dural tubes separated by osseous bridge (*arrows*).

Type 2 Diastematomyelia: Axial T2-weighted MR image shows splitting of distal cord into two hemicords (*arrows*) within single dural tube.

Sagittal T1 weighted MR image shows herniation of cerebral tonsil through the foramen magnumcharacteristic of Arnold chiari I malformation.

Coronal T2 weighted images showing butterfly vertebra and hemi vertebra and sagittal T2 weighted image shows block vertebra.

REFERENCES

1. Harwood-Nash D. “Computed tomography of the pediatric spine: a protocol for the 1980’s”. Radiol Clin North Am 1981; 19:479–94.
2. Lassman L, James C. “Lumbosacral lipomas: critical survey of 26 cases submitted to laminectomy”. J Neurol Neurosurg Psychiatry 1967; 30:174–81.
3. Winter R, Moe J, Lonstein J. “Posterior spinal arthrodesis for congenital scoliosis. An analysis of the cases of two hundred and ninety patients, five to nineteen years old”. J Bone Joint Surg 1984; 66:1188–97.
4. McMaster M. “Occult intraspinal anomalies and congenital scoliosis”. J Bone Joint Surg 1984; 66:588.
5. Blake N, Lynch A, Dowling F. “Spinal cord abnormalities in congenital scoliosis”. Ann Radiol 1986; 29:377–9.
6. Bradford D, Heithoff K, Cohen M. “Intraspinal abnormalities and congenital spine deformities: a radiographic and MRI study”. J Pediatr Orthop 991; 11:36–41.
7. Iskandar B, Oakes W, McLaughlin C, et al. “Terminal Syringohydromyelia and occult spinal dysraphism”. J Neurosurg 1994;81: 513–9.
8. De Wals P, Tairou F, Van Allen MI, et al. “Reduction in neural-tube defects after folic acid fortification in Canada”. *N Engl J Med*. July 12 2007; 357(2):135-42.
9. Kemal Sarica, et al. “Multidisciplinary Evaluation of Occult Spinal Dysraphism in 47 Children”. Scandinavian Journal of Urology and Nephrology, Sep 2003; 37(4):329-334(6)
10. Wataru W.S, Arthur W.P, Marvin A.K, “**Incidence of Spina Bifida Occulta in Relation to Age”.** *AMA J Dis Child*. 1956; 91(3):211-217.
11. Rajpal S, **ET AL. “TETHERED** cord due to spina bifida occulta presenting in adulthood: a tricenter review of 61 patients”. J Neurosurg Spine. Mar 2007; 6(3):210-5.
12. Bulent D, Selcuk G, Halil I S, Seref B, Engin G. “Tethered Cord Syndrome in Adulthood”. J Spinal Cord Med. 2008; 31(3): 272–278.
13. Koyanagi I, Iwasaki Y, Hida K, Abe H, Isu T, Akino M. “Surgical treatment of syringomyelia associated with spinal dysraphism”. Childs Nerv Syst. Apr 1997; 13(4):194-200.
14. Y. C. Gan, S. Sgouros, A. R. Walsh, A. D. Hockley. “Diastematomyelia in children: treatment outcome and natural history of associated syringomyelia”. Child's Nervous System; 23(5): 515-519

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