

## Role of CT and MRI in the evaluation of spinal dysraphism

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### Abstract

#### Aims & Objectives

To assess the role of Helical CT and MRI in

- The identification of various forms of Spinal dysraphism.
- Characterization of the lesions and associated anomalies.
- Giving a composite diagnosis based on specific Imaging findings

**Methodology:** The study included 35 patients referred to Department of Radiodiagnosis with signs and symptoms of Spinal dysraphism, over a period of 10 months. All patients were subjected to MRI using 1.5T Philips Achieva MRI machine.

**Results:** The most common type of spinal dysraphism is open spinal dysraphism accounting for 80% of the total 35 cases. The most common open spinal dysraphism is Myelomeningocele.

**Conclusion:** MRI is the imaging modality of choice for evaluation of the soft tissue anomalies of Spinal dysraphism especially spinal cord anomalies.

Multiplanar reformatted CT is an excellent imaging modality for characterization of vertebral segmentation defects, spinal curvature anomalies associated with spinal dysraphism. Thus CT and MRI together play an important role in the complete radiological evaluation of spinal dysraphism.

**Keywords:** CT, MRI, Spinal Dysraphism.

#### Introduction

Spinal dysraphism is the most common Neural tube defect in developing countries like India. The incidence varies from 0.5 to 11 per 1000 live births in different parts of our country, largely affecting the lower socioeconomic strata of the population.

The etiology of Neural tube defects is Multifactorial. The interaction of diverse factors related to Genetics,

Nutrition and Environment play an important role in the etiopathogenesis. Some of the environmental factors that may contribute to Open Neural Tube Defects are uncontrolled maternal diabetes, and certain prescription medications. It has been proved that deficiency of essential vitamins especially Folic acid during pregnancy results in higher incidence of Neural tube defects which led to prophylactic supplementation of folic acid in the antenatal period.

Spinal dysraphism is a broad term encompassing a heterogeneous group of congenital spinal anomalies, which results from defective closure of the neural tube during early fetal life. Spinal dysraphism can be classified as Spina Bifida Aperta and Spina Bifida Occulta.

Spina bifida aperta is most common type of spinal dysraphism representing a serious congenital anomaly with severe Neurologic, Musculoskeletal, Genitourinary, and Bowel anomalies. It encompasses three forms namely Myelomeningocele, Myelocele and rarely Meningocele. Females show a higher incidence than Males and most of them present at birth and are immediately taken for surgical repair and hence are rarely imaged in unoperated cases.

Spina bifida occulta is characterized by minor Neurological manifestations and presents at a later age. Most distinct clinical findings are cutaneous stigmata like Dermal dimple, Hemangioma, Cutis aplasia, Dermal sinus, or Hairy patch, Rudimentary tail (caudal appendage).

Segmentation anomalies of spine are a common feature of spinal dysraphism and along with muscle imbalances due to motor deficits result in Spinal curvature anomalies like Scoliosis, Kyphosis and Lordosis. Scoliosis is the most common type of spinal curvature

anomaly. Associated anomalies include Chiari malformations, Hydromyelia and Hydrocephalus.

### **Methodology**

This study on “**ROLE OF CT AND MRI IN THE EVALUATION OF SPINAL DYSRAPHISM**” has been carried out in the Department of Radio-diagnosis, Mahadevappa Rampure Medical College, Kalaburagi. A total number of 35 patients with clinical and laboratory features suggestive of spinal dysraphism of all age groups and either sex referred to the Department of Radiodiagnosis over a period of 10 months i.e. between 1<sup>st</sup> March 2022 to 31<sup>st</sup> December 2022 were included in this study. The study protocol was approved by the ethical committee. All the patients gave informed consent to participate in the study.

Patients were excluded if considered unsuitable for MRI. MRI was performed by using Philips Achieva 1.5 Tesla MRI machine.

### **Inclusion Criteria**

- All cases of open spinal dysraphism.
- Cases presenting with lumbosacral swelling.
- Cases presenting with cutaneous stigmata like Dermal dimple, tuft of hair, Nevi, dermal sinus.
- Cases showing vertebral anomalies in Plain radiograph.
- Cases presenting with congenital scoliosis/ kyphoscoliosis/ lordosis ect.
- Cases presenting with bladder/bowel incontinence since childhood.
- Cases presenting with motor or sensory deficit since childhood.

### **Exclusion Criteria**

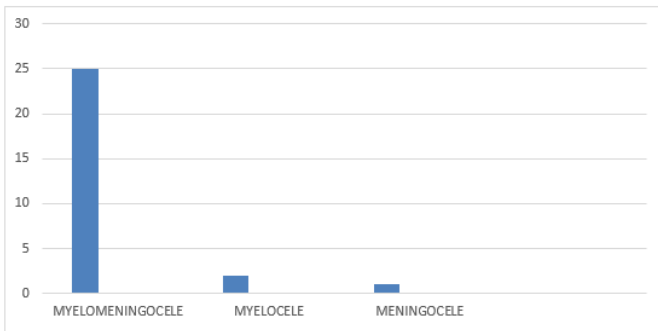
- Treated cases.
- Spinal tumors.

**Results**

**Table 1: Open Spinal Dysraphism**

Sn.	Type	Number of cases	percentage
			(Out of 35)
1	Myelomeningocele	25	71.4%
2	Myelocele	2	5.7%
2	Meningocele	1	2.9%
	<b>Total</b>	<b>28</b>	<b>80%</b>

**Figure 1**

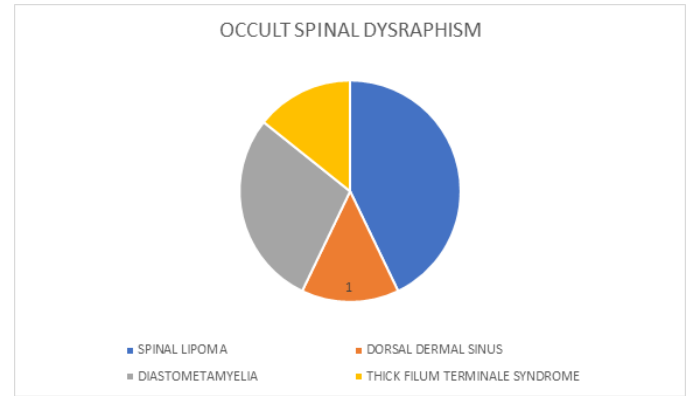


**Table 2: Occult Spinal Dysraphism**

Sn.	Type	Number of cases	(Percentage
			Out of 35)
1	Spinal lipomas	3	8.57%
2	Diastematomyelia	2	5.71%
3	Dorsal dermal sinus	1	2.8%
4	Tight filum terminale	1	2.8%
	<b>Total</b>	<b>7</b>	<b>20%</b>

Occult spinal dysraphism accounted for 20% of the total 35 cases.

**Figure 2**

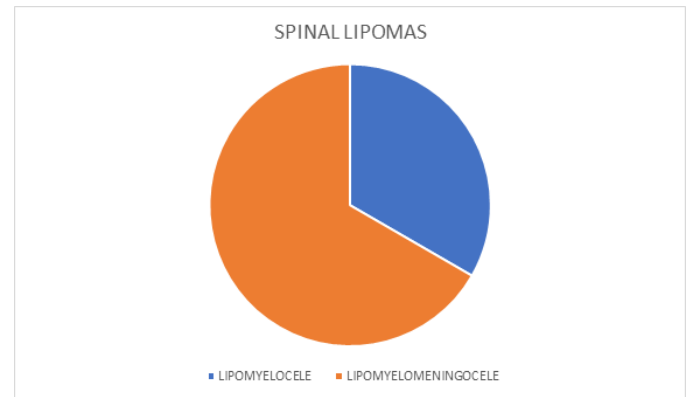


**Table 3: Spinal Lipomas**

Type	Number of cases	%
Lipomyelocele	1	33.6%
Lip myelomeningocele	2	66.4%

Lip myelomeningocele is the most common type of spinal lipoma accounting for 66% of the total cases.

**Figure 3**



**Table 4: Hydrocephalus in spinal dysraphism**

Type	Hydrocephalus		
	Present	Absent	Total
Open SD	10	18	28
Occult SD	4	3	7
<b>Total</b>	<b>14</b>	<b>21</b>	<b>35</b>
<b>%</b>	<b>42.86</b>	<b>57.14</b>	<b>100</b>

Hydrocephalus is present in 42.86% of the total cases.

Hydrocephalus is more common in Open spinal dysraphism.

Table 5: Chiari Association

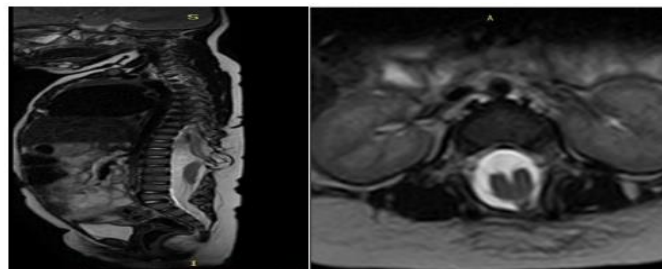
Type	Chiari II	Chiari I	%
Open SD	25	0	92.5%
Occult SD	0	2	7.5%

Chiari II malformation is associated with open spinal dysraphism in 92.5% of cases.

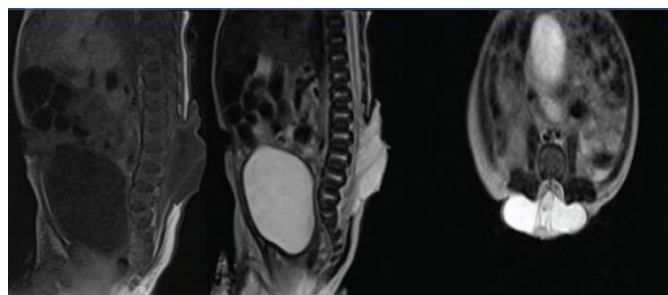
Chiari I malformation is associated with occult spinal dysraphism in 7.5% of cases.

Table 6: Comparison of CT And MRI In Spinal Dysraphism

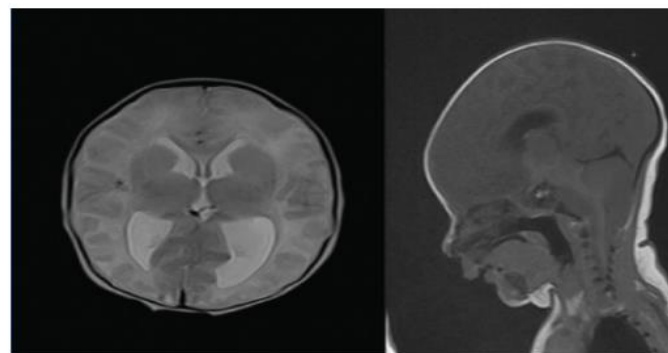
Sn.	Characteristics	CT	MRI
1	Open Spinal Dysraphism		
	Meningomyelocele	++	++++
	Myelocele	++	++++
	Meningocele	++	++++
2	Occult Spinal Dysraphism		
	Spinal lipomas	++	++++
	Dorsal dermal sinus	++	++++
	Tight filum terminal	+	++++
3	Distribution In Spine	+++	+++
4	Chiari Association	++	++++
5	Hydromyelia	++	++++
6	Hydrocephalus	++	++++



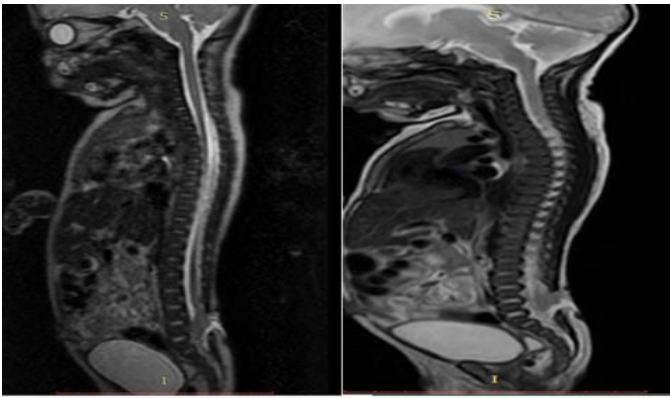
Spinal cord is split into two hemicords, each having one set of dorsal and ventral nerve roots. Each has its own dural sheath. They are separated by fibrous, bony or cartilaginous septae associated with bony abnormalities such as split or fused vertebrae.



Sagittal T1 and T2 W, axial T2W MR Images showing lumbosacral myelomeningocele.



Axial T2 W and Sagittal T1 W MR Image showing hydrocephalus and cerebellar tonsillar herniation.



A meningocele is a defect consisting of a herniation of meningeal tissue through a defect in the skull and / spine. Myelomeningocele is a defect consisting of a herniation of meningeal tissue and nervous tissue through a defect in the skull/ spine.

### **Discussion**

A total of 35 cases of spinal dysraphism were analyzed using Helical CT and MRI.

### **Incidence**

28 Patients were of open spinal dysraphism type and 7 patients were of occult spinal dysraphism accounting for 80% and 20% respectively.

### **Gender**

In open spinal dysraphism there were 11 males and 17 females accounting for 39.2% and 60.8% respectively thus showing female predominance (M:F 1:1.5).

In occult spinal dysraphism males constituted 5 cases and females 2 cases accounting for 71.43 % and 28.53% respectively showing marked male predominance. (M: F 2.5:1).

### **Age of Presentation**

All cases of open Spinal dysraphism occurred in the first two years of life with no cases beyond that age group (Mean age of presentation is 1.23yrs). Occult Spinal dysraphism patients presented at later age group in the first, second and third decade with most of the cases

occurring in the first decade. (Mean age of presentation is 6.6 yrs).

### **Neurological Complications**

Severe neurological complications were reported in all the cases of open Spinal dysraphism. In occult Spinal dysraphism neurological manifestations were less severe and were present in 5 of the 7 cases.

### **Cutaneous Signs**

Among the cutaneous manifestations of Occult Spinal dysraphism most common finding was mass in the back (50%) predominantly in the Lumbosacral region followed by Dermal dimple, Hypertrichosis, Silky hair, Dermal sinus, Capillary hemangioma etc.

### **Open Spinal Dysraphism**

Among the open Spinal dysraphism the most common lesion was Myelomeningocele accounting for 25 cases out of 28 cases (94.64%) followed by Myelocele 2cases (3.57%) and Meningocele 1 case (1.79%). The lesions were distributed in the Cervical, Dorsal, Lumbar and Lumbosacral regions. The Lumbosacral region was the most common site accounting for 39.29% followed by lumbar (32.14%) and dorsal (Mean age of presentation is 6.6 yrs).

### **Occult Spinal Dysraphism**

Among the occult SD, Spinal lipomas accounted for 3 out of 7 cases (42.86%). The most common spinal lipoma was Lipomyelomeningocele accounting for 66.6% of spinal lipomas followed by Lipomyelocele accounting for 33.3%. Dorsal dermal sinus occurred in only one case accounting for 1.42% proving that it is an uncommon lesion in our series.

Tight filum terminale syndrome accounted for only 1.42% in our series proving that it is an uncommon lesion among the occult SD.

Diastematomyelia accounted for 5.71% in our series proving that it is an uncommon lesion among the occult SD.

### **Spina Bifida Distribution**

Spina bifida was most common in Lumbosacral spine followed by Lumbar spine Dorsal spine and Cervical which also showed predominant involvement of spina bifida in the Lumbosacral spine.

### **Spinal Curvature Anomalies**

The most common spinal curvature anomaly was scoliosis (31.43%) followed by Kyphosis (20%) and Lordosis (10%). In Open spinal dysraphism, Scoliosis was most common in dorsal spine (6 cases) followed by Lumbosacral region (5 cases). Occult spinal dysraphism also showed similar distribution. In both open and occult Spinal dysraphism Kyphosis was most common in dorsal spine followed by Lumbar spine. Lordosis occurred in lumbar spine.

### **Hydromyelia**

Hydromyelia was present in 11 of the total 35 cases accounting for 33.3%. 8 cases belonged to Open Spinal dysraphism while occult Spinal dysraphism comprised 3 cases.

### **Chiari Malformations**

Chiari II malformation occurred in 25 of the 27 cases in open Spinal dysraphism accounting for 92.5%.

Chiari I was accounting for 7.5%.

### **Hydrocephalus**

Hydrocephalus was present in 10 out 18 cases in open spinal dysraphism and 4 out of 7 in cases of occult spinal dysraphism, constituting 42.86% of total cases.

### **Conclusion**

MRI is the imaging modality of choice for evaluation of the soft tissue anomalies of Spinal dysraphism especially spinal cord anomalies.

Multiplanar reformatted CT is an excellent imaging modality for characterization of vertebral segmentation defects, spinal curvature anomalies associated with spinal dysraphism.

Thus CT and MRI together play an important role in the complete radiological evaluation of spinal dysraphism.

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