ORIGINAL RESEARCH PAPER

Radio-Diagnosis

ENHANCING DIAGNOSTIC PRECISION: "THE ROLE OF MRI IN ASSESSING PAEDIATRIC SPINAL DYSRAPHISM"

KEY WORDS:

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INTRODUCTION

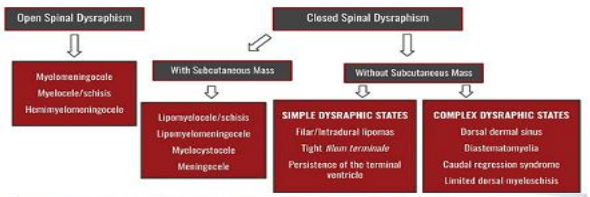
Context: Paediatric spinal dysraphism constitutes a spectrum of congenital anomalies arising from incomplete neural tube closure during embryogenesis. This disrupts spinal cord development and vertebral alignment.Examples include overt forms such as myelomeningocele and meningocele, alongside occult variants like tethered cord syndrome.

RELEVANCE: Accurate diagnosis and characterisation of spinal dysraphism are paramount for timely intervention, as delays can exacerbate irreversible neurological damage.Magnetic Resonance Imaging (MRI) offers superior soft tissue contrast and multiplanar capabilities, facilitating precise delineation of anomalies and associated conditions such as Chiari malformation or syringomyelia.Such information is critical for surgical planning and multidisciplinary management in paediatric neuroimaging

GAP IN KNOWLEDGE: There remains a paucity of region specific data on MRI's diagnostic performance metrics in a dedicated paediatric cohort from resource constrained settings, This is particularly true for correlations with clinical outcomes and postoperative assessments, limiting evidence based protocols for routine clinical application

CLASSIFICATION OF SPINAL DYSRAPHISM

Clinico-Radiological Classification of Spinal Dysraphisms



Open Spinal Dysraphisms: not covered by intact skin	
Myelocele	Neural placode flush with skin surface
Myelomeningocele	Neural placode protrudes above skin surface
Hemimyelocele	Myelocele associated with diastematomyelia
Hemimyelomeningocele	Myelomeningocele associated with diastematomyelia
Closed Spinal Dysraphism: covered by intact skin With a subcutaneous mass	
Lipomyelocele	Placode-lipoma interface within the spinal canal
Lipomyelomeningocele	Placode-lipoma interface outside of the spinal canal
Meningocele	Herniation of CSF-filled sac lined by dura
Terminal myelocystocele	Terminal syrinx herniating into posterior meningocele
Myelocystocele	Dilated central canal herniating through posterior spina bifida
Without a subcutaneous mass	
Simple dysraphism states	
Intradural lipoma	Lipoma within the dural sac
Filar lipoma	Fibrolipomatous thickening of filum
Tight filum terminale	Hypertrophy and shortening of filum
Persistent terminal ventricle	Persistent cavity within conus medullaris
Dermal sinus	Epithelial lined fistula between neural tissue and skin surface
Complex dysraphism states	
Dorsal enteric fistula	Connection between bowel and skin surface
Neurenteric cyst	More localized form of dorsal enteric fistula
Diastematomyelia	Separation of cord into two hemicords
Caudal agenesis	Total or partial agenesis of spinal column
Segmental spinal dysgenesis	Various segmentation anomalies

OBJECTIVES

- The primary aim of this study is to evaluate the efficacy of magnetic resonance imaging (MRI) in diagnosing and characterising paediatric spinal dysraphism, including subtype identification and associated anomalies
- Secondary objectives include correlating MRI findings with clinical symptoms and neurological assessments, assessing its utility in guiding surgical interventions, and determining diagnostic performance metrics to inform evidencebased management protocols

MATERIAL AND METHODS

Study design: A single centre, hospital based, retrospective observational study.

Duration: 1st March 2025 to 31st August 2025

Study Setting: Department of Radiodiagnosis, Index Medical College, Indore.

Data Source: Comprehensive review of health records.
Sample size and population details: 32 consecutive paediatric patients

Imaging modality/techniques used: Dedicated spinal MRI protocol on a 1.5 Tesla Siemens Magnetom scanner, incorporating multiplanar T1weighted (TR/TE: 500/15 ms), T2weighted (TR/TE: 3000/90 ms), and fatsaturated sequences; field of view tailored to 20–25 cm with 3 mm slice thickness to optimise visualisation of lumbosacral defects, spinal cord tethering, and intrathecal anomalies

Inclusion criteria: confirmed spinal dysraphism diagnosis via multidisciplinary team review (neurology, neurosurgery, radiology) and MRI demonstrated neural tube defects.

Exclusion criteria: incomplete pre or postoperative imaging, MRI incompatible metallic artefacts, or comorbid nonneural spinal pathologies (e.g., trauma induced lesions).

Data collection: Retrospective review of medical records, MRI reports, surgical notes, and followup assessments; variables included demographics, symptoms (motor deficits, bladder/bowel dysfunction), neurological findings, and outcome measures.

RESULTS

Table 1: Characteristics of Participants

Characteristic	n (%) or Mean (Range)
Age Groups	
0–2 years	14 (43.8%)
3–5 years	12 (37.5%)
6–8 years	4 (12.5%)
9–12 years	2 (6.2%)
Overall mean age	4.2 years (0–12)
Gender	
Male	18 (56.3%)
Female	14 (43.7%)

Table 2: Presenting Symptoms

Bladder dysfunction	20 (62.5%)
Bowel incontinence	15 (46.9%)
Combination of symptoms	12 (37.5%)
Bladder dysfunction	8 (25.0%)
Neurological Findings	
Lower limb weakness	18 (56.3%)
Sensory deficits	10 (31.3%)
Symptom Onset	
At birth (including visible defects in 14)	22 (68.8%)
Delayed (mean 3.6 months, range 1–6)	10 (31.3%)
Management Approach	
Surgical intervention	22 (68.8%)
Nonsurgical (conservative)	10 (31.3%)

Table 3: MRI Finding/Anomaly

Spinal Dysraphism Subtypes	n (%)
Myelomeningocele	18 (56.3%)
Meningocele	10 (31.3%)
Diastematomyelia	4 (12.5%)
Filar Lipoma	3 (9.4%)
Lipomyelocele	1 (3.1%)
Myelomeningocele	18 (56.3%)
Associated Anomalies	
Chiari malformation	12 (37.5%)
Syringomyelia	6 (18.8%)
Hydrocephalus	5 (15.6%)

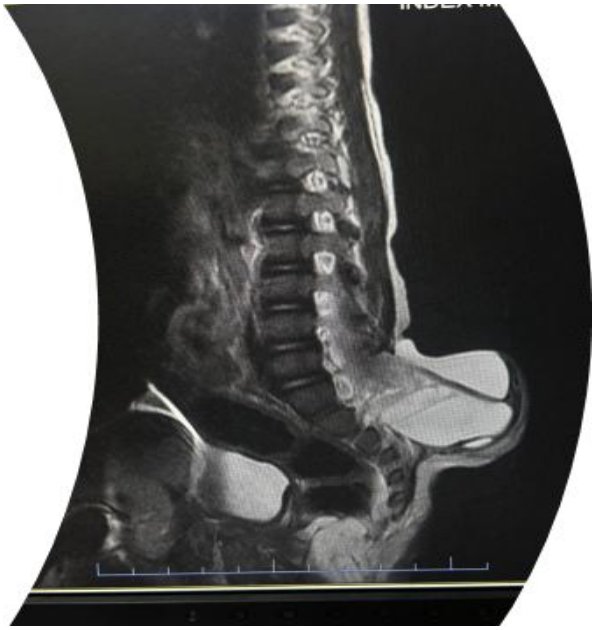
Table 4: Clinical Outcome and Accuracy of MRI

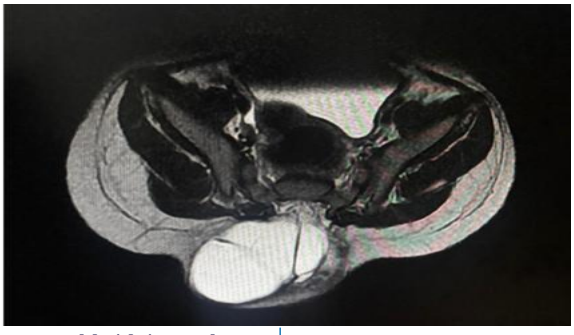
Outcome/Metric	n (%) or Value
Postoperative MRI (Surgical Cases, n=22)	
Successful defect closure	18 (81.8%)
Partial correction	4 (18.2%)
Neurological Improvements at 6 Month Follow-up (Surgical, n=22)	
Enhanced motor function	12 (54.5%)
Reduced bladder dysfunction	9 (40.9%)
Non Surgical Cases (n=10)	
Stable condition	10 (100%)
MRI Diagnostic Performance	
Sensitivity	95%
Specificity	90%
Positive Predictive Value	93%
Negative Predictive Value	92%

CASES AND DISCUSSION

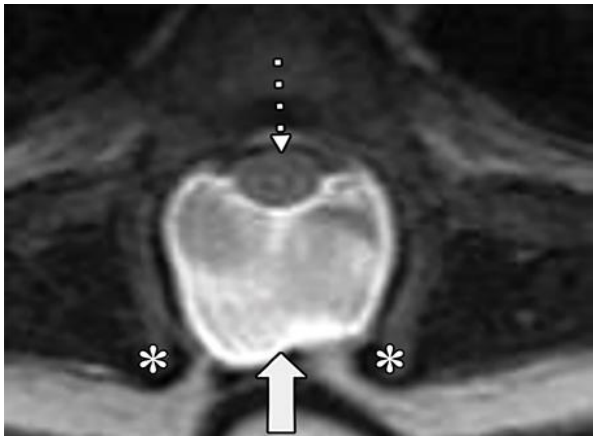
- Myelomeningocele:- Saggital and axial T2WI image showing

Neural placode protrudes above skin surface with associated expansion of subarachnoid space.





fluid (CSF)–filled meningeal hernia (solid arrow) through a posterior spina bifida (*). The thoracic spinal cord is normal (dotted arrow), and there are no neural elements inside the outpouching.



DIASTEMATOMYELIA

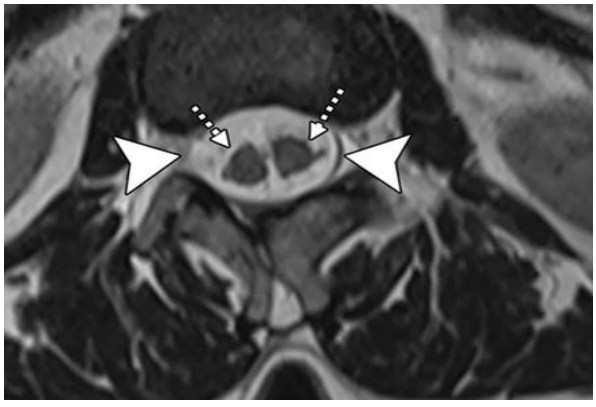
Diastematomyelia, a type of split-cord malformation, is defined by division of the spinal cord into two hemicords.

It is of 2 types :

Type I with bony spur in between and Type II without bony spur in between.

AXIAL T2WI showing :

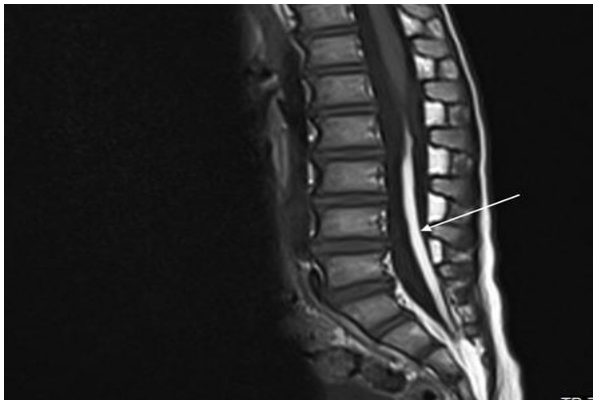
Type II diastematomyelia show a spinal cord split into two hemicords both surrounded by the same and only dural sac with no identified osteocartilaginous or bony spur.



FILAR LIPOMA

Sagittal T2WI showing :

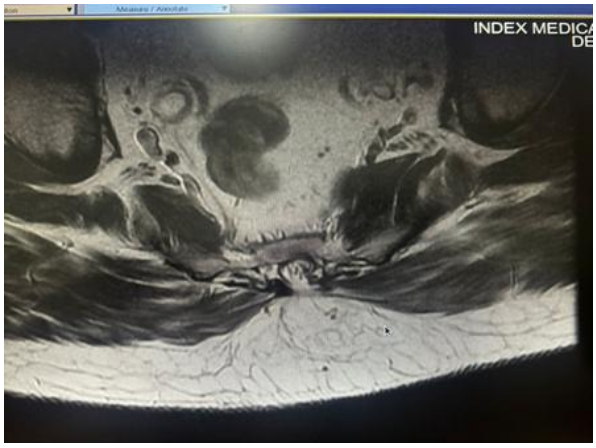
Fibrolipomatosis , thickening of filum (>2mm) in lumbosacral region.

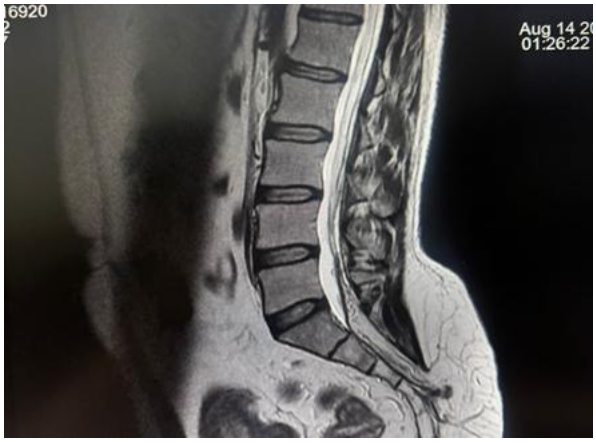


LIPOMYLOCELE

- T2WI Axial and saggital images of the lumbosacral spine

showing a lipomatous mass insinuating into the spinal canal and communicating with the subcutaneous region posteriorly. The placode-lipoma interface is located at the level of the neural arches, without expansion of the subarachnoid space.





DISUCSSION

- These findings substantiate the superior diagnostic accuracy of MRI in paediatric spinal dysraphism.
- MRI facilitated precise anatomical characterisation and informed therapeutic strategies to avert progressive neurological compromise
- The observed 81.8% rate of successful surgical closure, coupled with neurological enhancements in 54.5% of cases (e.g., motor function improvement), illustrates MRI's instrumental contribution to preoperative delineation and postoperative appraisal.

LIMITATIONS

- Retrospective methodology
- Small sample size (n=32).