Intraspinal MRI Abnormalities in Early-Onset Scoliosis – Rates Across a Global Cohort

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Background

- Spinal MRI is commonly included in the evaluation of EOS due to higher frequencies of intraspinal abnormalities reported in this population

- MRI findings across a diverse, multi-center EOS cohort have not been previously described

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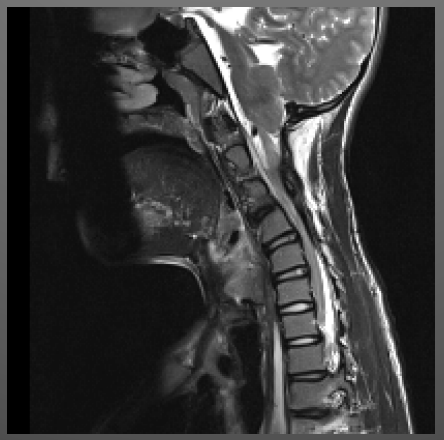
Objectives

1) To report on the rate and type of abnormalities identified by spinal MRI from a diverse EOS cohort within an international patient registry

2) To identify patient-related factors associated with a higher likelihood of MRI abnormality



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Methods

Design: *Retrospective review of a prospective, multi-center database*

Inclusion criteria: *Idiopathic, Congenital, Neuromuscular or Syndromic EOS patients in whom MRI was obtained*

Exclusion criteria:

- *Incomplete or unverifiable data regarding pre-treatment imaging*
- *Structural deformities secondary to tumor or infection*

Independent variables:

- *Patient demographics: Age, race/ethnicity*
- *Etiology of EOS*
- *Major curve size (Degrees)*
- *Type of treatment (Operative or Non-operative)*

Dependent variable: *Presence (**MRI+**) or absence (**MRI-**) of MRI abnormality*

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Statistical Analysis

- Demographic, clinical and radiographic characteristics summarized with descriptive statistics
- MRI findings were summarized with frequency distributions by abnormality type, patient and EOS Etiology
- Univariate analyses were performed using Pearson's chi-square (χ^2) for categorical variables and two-tailed student's t-test for continuous variables
- Multivariate logistic regression was performed to identify significant predictors of MRI abnormality

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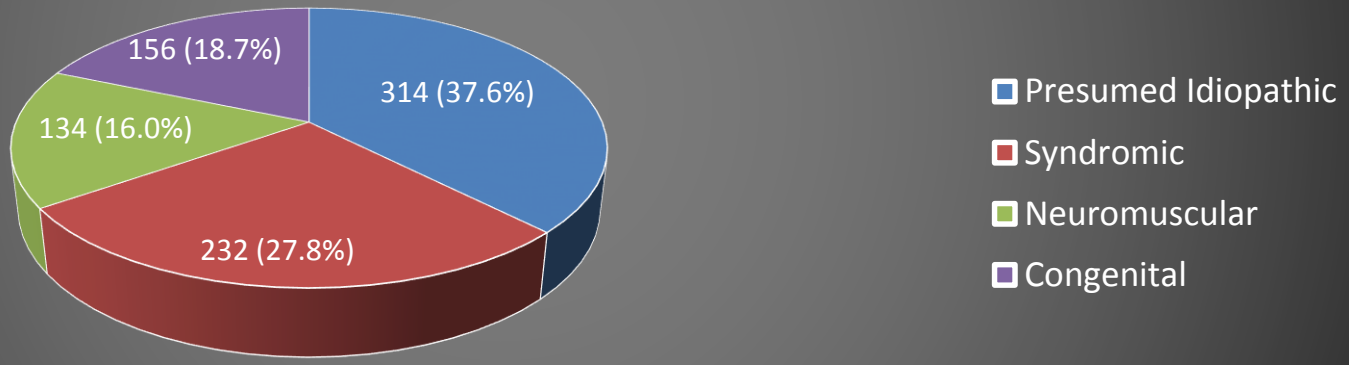
Cohort Demographics

- MRIs were obtained in 836 of 1,343 (62%) of registry subjects meeting inclusion criteria at mean age of 5.8 +/- 4.0 years old

Etiology Distribution of Patients Undergoing MRI



- 23.6% (197/836) of patients had positive MRI findings

- 247 unique MRI abnormalities were identified

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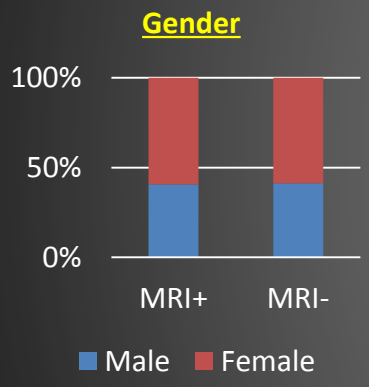
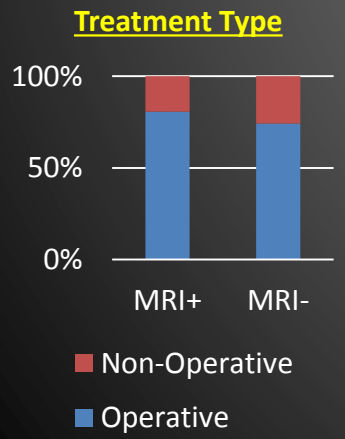
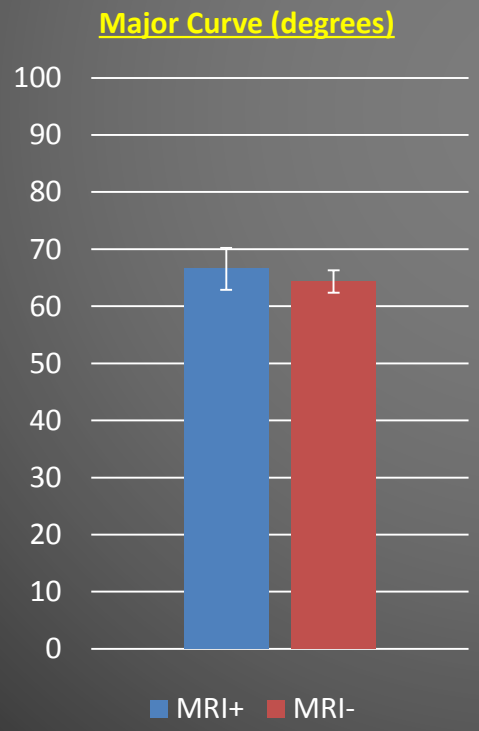
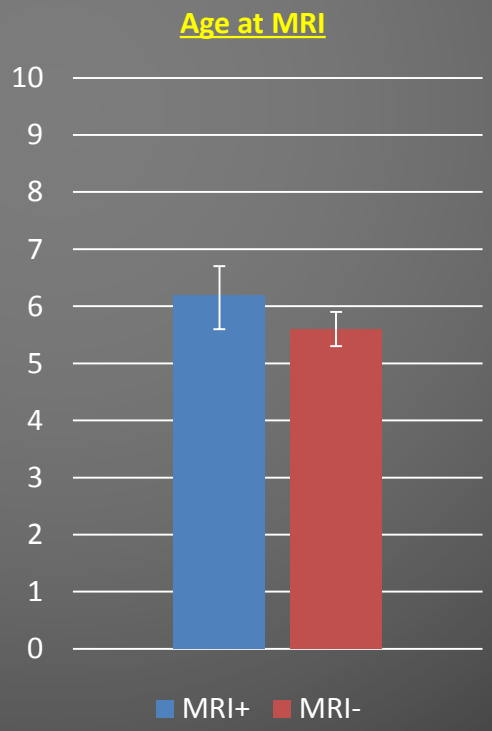
Univariate Analyses

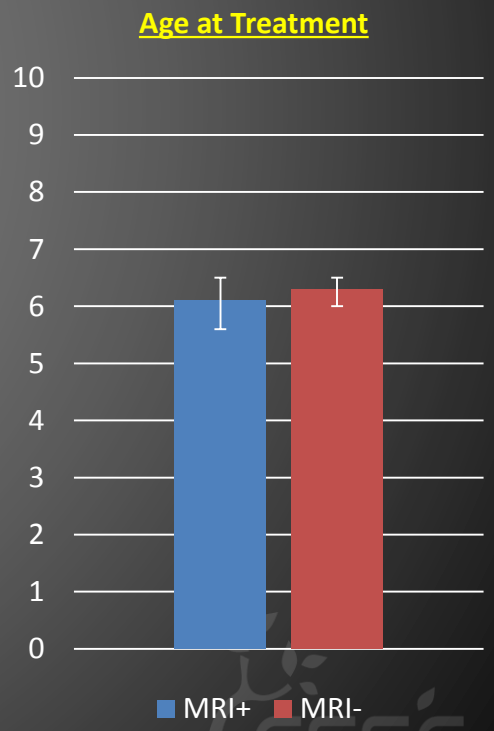
- MRI+ showed no association (p>0.05) with gender, treatment type, major curve size, age at MRI and age at treatment











MRI Abnormalities - By Race/Ethnicity

Univariate Analysis

Race/Ethnicty	Abnormal (MRI+) n = 197 (23%)	Normal (MRI-) n = 639 (76%)	p-value
White/Caucasian	114 (57.9%)	410 (64.2%)	P = 0.002
African/African-American	23 (11.7%)	89 (13.9%)	
Hispanic	15 (7.6%)	57 (8.9%)	
Asian/Asian-American	18 (9.1%)	19 (3.0%)	
Other/Unspecified	27 (13.7%)	64 (10.0%)	

Multivariate Regression

Race/Ethnicity	Odd Ratio	95% CI	Adjusted OR*	95% CI
White/Caucasian	1*		1*	
African/African-American	0.9	(0.56, 1.54)	0.8	(0.48, 1.37)
Hispanic	1	(0.52, 1.73)	0.7	(0.37, 1.31)
Asian/Asian-American	3.4	(1.73, 6.71)	2.8	(1.39, 5.68)
Other/Unspecified	1.5	(0.93, 2.49)	1.3	(0.77, 2.15)

*Adjusted for etiology

MRI Abnormalities - By Etiology

Univariate Analysis

Etiology	Abnormal (MRI+) n = 197 (23%)	Normal (MRI-) n = 639 (76%)	P - value
Presumed Idiopathic	42 (21.3%)	272 (42.6%)	P < 0.001
Syndromic	48 (24.4%)	184 (28.8%)	
Neuromuscular	52 (26.4%)	82 (12.8%)	
Congenital	55 (27.9%)	101 (15.8%)	

Multivariate Regression

Etiology	Odd Ratio	95% CI	Adjusted OR*	95% CI
Syndromic	1*		1*	
Neuromuscular	2.4	(1.52, 3.89)	2.5	(1.55, 4.02)
Idiopathic	0.6	(0.38, 0.93)	0.6	(0.38, 0.96)
Congenital	2.1	(1.32, 3.30)	2.1	(1.31, 3.33)

*Adjusted for race/ethnicity

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MRI Abnormality Distribution - By Patient

Patient MRI Findings	N (%)
Syrinx	43 (21.8%)
Tethered Cord with or without Fatty Filum	39 (19.8%)
Canal Abnormality	24 (12.2%)
Chiari Malformation	19 (9.6%)
Chiari Malformation and Syrinx	10 (5.1%)
Fatty Filum	9 (4.6%)
Syrinx And Tethered Cord	7 (3.6%)
Lipoma/Lipomeningocele	7 (3.6%)
Chiari Malformation and Spina Bifida	6 (3.0%)
Spina Bifida	6 (3.0%)
Other	5 (2.5%)
Dural Ectasia	4 (2.0%)
Syrinx and Fatty Filum	2 (1.0%)
Chiari Malformation, Syrinx and Tethered Cord	2 (1.0%)
Chiari Malformation and Tethered Cord	1 (0.5%)

Top 5 MRI Findings Within Each EOS Etiology

	Syndromic (n=48)	Neuromuscular (n=52)	Presumed Idiopathic (n = 41)	Congenital (n=55)
1.	Tethered cord - 11	Chiari Malformation - 9	Syrinx - 18	Tethered Cord +/- Fatty Filum - 19
2.	Syrinx - 9	Canal Abnormality +/- Other finding - 8	Chiari Malformation - 9	Syrinx - 10
3.	Canal Abnormality - 8	Chiari Malformation and Spina Bifida - 6	Chiari Malformation + Syrinx - 5	Canal Abnormality - 5
4.	Fatty Filum - 4	Syrinx - 6	Canal Abnormality - 4	Lipoma or Lipomeningocele - 4
5.	Dural Ectasia - 3	Tethered Cord - 6	Tethered Cord +/- Fatty Filum - 3	Fatty Filum - 4

Discussion

- In the largest and most diverse EOS cohort to date, a 24% rate of MRI abnormality was identified
- Multivariate logistic regression demonstrated:
  - Increased Odds for MRI Abnormality among *Asian/Asian-American* (2.8x vs. White/Caucasian), *Congenital* (2.1x vs. Syndromic) and *Neuromuscular* (2.5x vs. Syndromic) patients
  - Decreased Odds for MRI Abnormality among *Idiopathic* (0.6 vs. Syndromic) patients
- The most frequent abnormalities seen were Syrinx (22%) and Tethered cord (20%)
- The most common MRI findings in each etiologic subgroup are described

Limitations

- Registry studies rely upon the accuracy and consistency of data collected at participating centers
- No standardization of MRI review - Reported imaging findings based on each institution's local radiology report
- Other potential risk factors for MRI abnormality (e.g. physical exam findings) not available for inclusion

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