ORIGINAL ARTICLE

# Snapshot of MRI Neural Axis Abnormalities in Consecutive Cohort of Pediatric and Young Adult Patients Undergoing Spinal Deformity Correction in a Tertiary Care Hospital in Pakistan

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## ABSTRACT

**Objective:** To determine the frequency and types of neural axis anomalies in a consecutive cohort of paediatric and young adult patients undergoing spinal deformity correction surgery for Scoliosis.

**Methods:** This retrospective Cohort study was conducted in Department Orthopedics and Spine Centre, Ghurki trust Teaching Hospital Lahore. The medical records of all paediatric and young adult Scoliosis patients meeting the inclusion criteria and operated for corrective surgery from 23rd January 2015 to 25th December 2018 were reviewed. The demographic details, clinical findings, radiographs and MRI findings were noted. The frequencies of different neural axis abnormalities detected on MRI in idiopathic and congenital scoliosis were compared and statistical significance was determined by calculating *P* value with the help of Chi square test. *P* value $< 0.05$ was considered significant.

**Results:** A total of 87 patients with mean age 13.7 ± 3.87 years were included in our study. Male patients were 29(33.3%) and female 58(66.7%). Idiopathic Scoliosis was noted in 56(64.4%) patients and congenital in 31(35.6%). Maximum number (n=51,58.6%) of patients had no neural axis pathologies detected on MRI. However large number (n=36,41.3%) of patients had divergent neural axis abnormalities. Syringomyelia was the commonest MRI pathology seen in 10(11.4%) patients followed by Conus in 9(10.3%), Diastomyelia in 4(4.5%), Hydromyelia in 3(3.4%), Tethered Cord in 2(2.2%), Arnold-Chiari malformation in 2(2.2%), Tonsillar Ectopia in 2 (2.29%), Dural Fault in 2(2.2%), Foramen Magnum compression in 1(1.5%) and OS Odontoideum in 1(1.14%) patient. The frequencies of these anomalies in idiopathic and congenital Scoliosis were compared and found statistically insignificant (*P* value >0.05)

**Conclusion:** Large number of paediatric and young adult patients undergoing spinal deformity correction surgery for Scoliosis had neural axis anomalies detected on MRI. Syringomyelia and Conus were the most frequently noted anomalies. We recommend MRI as a mandatory pre operative investigation in all paediatric and young adult patients undergoing spinal deformity correction surgery for Scoliosis.

**Keywords:** Congenital, Conus, Idiopathic, Intraspinal anomalies, MRI, Scoliosis, Syringomyelia.

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## INTRODUCTION

Scoliosis is usually classified as idiopathic, congenital and neuromuscular with idiopathic being the most common type.[1] These types of scoliosis are diagnosed once other etiologies of scoliosis are excluded.[2] Although the exact aetiology of idiopathic scoliosis is unknown, subtypes into infantile idiopathic scoliosis (IIS), juvenile idiopathic scoliosis (JIS) and adolescent idiopathic scoliosis (AIS) are often used depending upon age of the patient.[3] The usual method of measuring curve progression in Scoliosis is plain radiography but use of advanced imaging modalities like Computed Tomography(CT) and Magnetic Resonance Imaging(MRI) have better explained the multi-planer nature of Scoliosis and helped in detecting underlying abnormalities with confidence.[4] Magnetic Resonance Imaging (MRI) has revolutionized the assessment of Scoliosis patients with intra-spinal anomalies in idiopathic and congenital scoliosis.[5,6] The advantage of pre-operative MRI in Scoliosis patient is to sort out cord anomalies which may cause complications during surgery.[7] Moreover MRI should be performed preferably in patients with right sided curves, long curves, thoracolumbar area apex and Hpyerthoracic kyphosis,[8] because 50 % anomalies in the juvenile and infantile idiopathic scoliosis are considered to be high.[9] Other risk factors for intra spinal anomalies associated with Scoliosis are male gender, age less than 10 years, right lumbar curve and large left thoracic curve and thus warrants pre operative MRI.[8] In Infantile and Juvenile Idiopathic Scoliosis intra-spinal pathologies vary from 18.7% to 50%.[3,9]

The routine use of pre-operative MRI to identify occult intra-spinal anomalies before surgical correction of paediatric spinal deformities is the widely accepted best practice recommendation globally. However due to economic and resource constraints these recommendations are not implemented in many health-care settings including our centre. Since the exact prevalence of occult congenital and developmental neural axis anomalies in adolescent Scoliosis are unknown in our population therefore we conducted this small scale retrospective Cohort study to determine the frequency and types of neural axis anomalies in a consecutive cohort of paediatric and young adult patients undergoing spinal deformity correction surgery. The results of our study will be used to review our guidelines of treating Scoliosis in our institution.

## METHODS

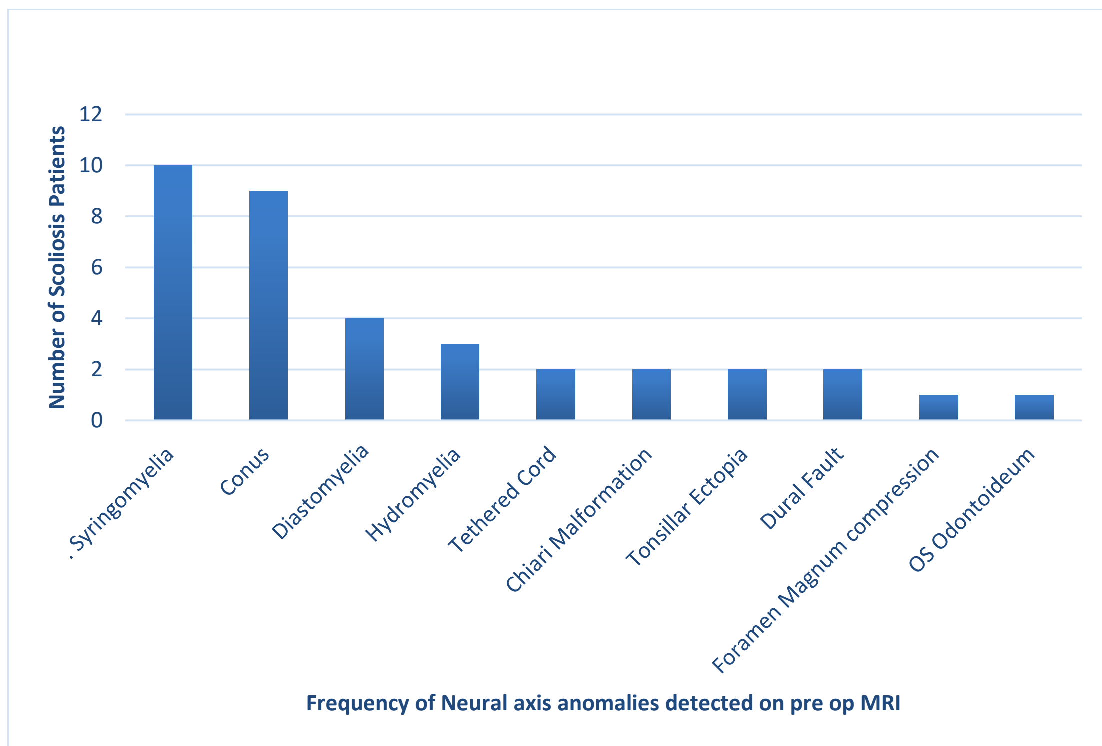
We conducted this retrospective Cohort study in Department Orthopedics and Spine Centre, Ghurki trust Teaching Hospital Lahore. The medical records of all paediatric and young adult scoliosis patients who were operated for corrective surgery from 23rd January 2015 to 25th December 2018 were reviewed. All patients of either gender with idiopathic and congenital scoliosis, both symptomatic and asymptomatic and with preoperative MRI and complete records were included. Scoliosis due to degenerative spine was excluded. The study protocols were approved by Ethical Committee of our hospital. In the included patients detailed review of radiological parameters included scoliosis series x-rays and MRI. Evaluation of MRI for occult neural axis anomalies were done by an experienced radiologist with minimum of 10 years post fellow ship experience in radiology. We reported our study in accordance with the STROBE guidelines.[10]

The data was analyzed with SPSS version 21. Quantitative variables like age was presented as mean and standard deviation while qualitative variables like type of occult anomaly was presented as frequency and percentages. The frequencies of different neural axis abnormalities detected on MRI in idiopathic and congenital Scoliosis were compared and statistical significance was determined by calculating *P* value with the help of Chi square test. *P* value < 0.05 was considered significant. Data was presented in table and graph where necessary.

## RESULTS

The medical record of 87 Scoliosis patients were reviewed. Mean age was 13.7 ± 3.87 years. Male patients were 29(33.3%) and female 58(66.7%). Majority(64.4%, n=56) of patients had Idiopathic scoliosis while congenital scoliosis was noted in 31(35.6%). Although maximum number(n=51,58.6%) of patients had no neural axis pathologies detected on MRI. However large number(n=36,41.3%) of patients had divergent neural axis abnormalities as shown in graph I. Syringomyelia was the commonest MRI pathology seen in 10(11.4%) patients followed by Conus in 9(10.3%), Diastomyelia in 4(4.5%), Hydromyelia in 3(3.4%), Tethered Cord in 2(2.2%), Arnold-Chiari Malformation in 2(2.2%), Tonsillar Ectopia in 2 (2.29%), Dural Fault in 2(2.2%), Foramen Magnum compression in 1(1.5%) and OS Odontoideum in 1(1.14%) patient. Preoperative neurological status

was compromised in 3(3.4%) patients in Idiopathic Scoliosis and 2(2.3%) in congenital Scoliosis. The frequencies of these anomalies in idiopathic and congenital Scoliosis were compared (table I) and found statistically insignificant (*P* value >0.05)




**Graph I:** Frequencies of different neural axis anomalies detected on pre op MRI.

**Table I:** Comparison of frequencies of different neural axis anomalies between Idiopathic and Congenital Scoliosis.

| S.NO | **Neural axis anomaly** | **Idiopathic Scoliosis(n=56)** | **Congenital Scoliosis(n=31)** | ***P* value** |
|---|---|---|---|---|
| 1 | Syringomyelia | 5(5.7%) | 5(5.7%) | 0.313 |
| 2 | Conus | 4(4.6%) | 5(5.7%) | 0.187 |
| 3 | Diastomyelia | 1(1.1%) | 3(3.4%) | 0.092 |
| 4 | Tethered Cord | 00 | 2(2.3%) | 0.054 |
| 5 | Arnold-Chiari malformation | 2(2.3%) | 00 | 0.287 |
| 6 | Dural Defects | 00 | 2(2.3%) | 0.054 |
| 7 | Foramen Magnum Compression | 2(2.3%) | 00 | 0.287 |

Among congenital scoliosis, one patient had diastomyelia at D7-8, D11-12-L1 levels, the other had L2-L3, and the third patient had diastomyelia at D10-12, L1 level. In case of idiopathic scoliosis one patient had diastomyelia of D10-L4,5. Conus in idiopathic scoliosis was noted at L1, L2, L3, L4-L5 while conus in congenital scoliosis was observed at L2, L4, L5-S1. Tethered cord was noted in two patients at S3-S4 level. The dural defects among two patients of congenital scoliosis were seen at D3, D4 and D9-L1 levels.

## DISCUSSION

The diverse spinal peculiarities like Syringomyelia and other intra spinal lesions can be a risk factor for neurological injury during surgical correction of Scoliosis.[11,12] Therefore identification of these anomalies are mandatory before surgical intervention. In our study neural axis anomalies were noted in 36/87(41.3%) patients on MRI. Syringomyelia was the commonest MRI pathology seen in 10(11.4%), Conus in 9(10.3%) and Arnold-

Chiari malformation in 2(2.3%) patients. Dobbs[13] documented that 10(21.7%) out of 46 patients had a neural pivot variation on magnetic resonance imaging with 5(50%) patients had an Arnold-Chiari malformation and a related cervico thoracic syrinx, 3(30%) had Syringomyelia, 1(10%) had a low-lying Conus and 1(10%) had a brainstem tumor.

Inoue[14] and his colleague reported that 44(18%) out of 250 patients had neural axis anomaly on MRI. Majority (50%,n=22) of their patients had Syringomyelia with Arnold-Chiari malformation, 13(29.5%) patients had Arnold-Chiari malformation,2(4.5%) had Syringomyelia with Tonsillar Ectopia,6(13.6% ) had Tonsillar Ectopia and 1( 2.2%) patient had Conus. Inoue performed foramen magnum decompression in 12(27.2%) patients before Scoliosis correction. This study concluded that decompression of foramen magnum before Scoliosis correction was mandatory to prevent neurological complications. However pre op MRI findings of neural axis malformation in idiopathic Scoliosis posed a little risk factor for neurological decorations in asymptomatic idiopathic Scoliosis.

Nakahara and Yonezawa[15] reported that 18(3.8%) out of 472 patients had neural axis pathologies on MRI. Arnold-Chiari malformation I was seen in 6(33.3%) patients,10(55.5%) had Arnold-Chiari I malformation combined with Syringomyelia, and 2(11.1%) had a Syringomyelia without Chiari I malformation. Male gender, patient age more than 11 years and abnormal superficial abdominal reflexes were related to discovering neural axis abnormalities on MRI.

In our study majority(64.4%, n=56) of patients had Idiopathic scoliosis while congenital scoliosis was noted in 31(35.6%).Jayaswal and Kandwal[16] documented predominantly congenital Scoliosis than idiopathic Scoliosis in their study with majority of their patients had tethered cord syndrome followed by Split cord malformation on pre operative MRI.

Syringomyelia was the commonest MRI pathology seen in 10(11.4%) patients in our study. Gupta[17] noted tethered cord anomaly in 48% of their patients in congenital Scoloiosis while Zhang3 and others [18-20] noted that Syringomyelia was the most common neural axis anomaly on pre op MRI.

There were few limitations of our study. Our sample size was small. We could not analyze the surgical outcome or complications of these neural axis anomalies. Further studies are therefore recommended to confirm our results.

## CONCLUSION

Large number of paediatric and young adult patients undergoing spinal deformity correction surgery for Scoliosis had neural axis anomalies detected on MRI. Syringomyelia and Conus were the most frequently noted anomalies. We recommend MRI as a mandatory pre-operative investigation in all paediatric and young adult patients undergoing spinal deformity correction surgery for Scoliosis.

**Conflict of Interest:** None

**Grants/Funding:** None

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