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FREQUENCY OF CLINICAL MANIFESTATIONS IN PATIENTS DIAGNOSED WITH SPINAL SCOLIOSIS USING MAGNETIC RESONANCE IMAGING: A CROSS-SECTIONAL STUDY

Fatima Mahrukh[*1], Maryam Khushbakhat[2], Komal Abrar[3], Rabbia Farrukh[4], Muhammad Yasir[5], Alina Saeed[6]

[*1]*School of Allied Health Sciences, CMH Lahore Medical College & Institute of Dentistry Lahore*
[2]*Clinical Pharmacist DHQ Hospital Sheikhupura*
[3]*Senior Lecturer Medical Imaging Technology*
[4]*4th year MBBS Scholar Federal Medical College Islamabad*
[5]*Department of Biological Sciences, The Superior University Lahore*
[6]*CMH Lahore Medical College & Institute of Dentistry Lahore*

[*1]fatimamahrukh1996@gmail.com, [2]maryamkhushbakhat13@gmail.com, [3]komalabrar96@gmail.com, [4]rabbiafarrukh5@gmail.com, [5]yasirbinabbas256@gmail.com, [6]alinasaeed450@gmail.com

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Corresponding Author: *
Fatima Mahrukh

Abstract

Introduction: *Spinal scoliosis is defined as a lateral curvature of the spine measuring at least 10 degrees on the Cobb angle. It may arise due to congenital vertebral anomalies, idiopathic causes, or neuromuscular and developmental conditions. Scoliosis is a major cause of spinal deformity and can be associated with a range of clinical manifestations depending on the severity and location of the curve. Patients may present with postural abnormalities, unequal shoulders or hips, and neurological symptoms such as pain, numbness, or radiculopathy. Magnetic resonance imaging (MRI) is a critical tool for diagnosing the underlying structural and neurological abnormalities associated with scoliosis. Early detection and classification of clinical features through MRI can help guide management strategies and reduce disability. This study aims to determine the frequency of clinical manifestations in scoliosis patients as confirmed by MRI findings.*

Objective: *To determine the frequency and distribution of clinical manifestations in patients diagnosed with spinal scoliosis using magnetic resonance imaging (MRI).*

Materials and Methods: *A descriptive, cross-sectional study was conducted at Ghurki Trust and Teaching Hospital, Lahore. A total of 100 patients presenting with symptoms suggestive of spinal deformity were screened, out of which 100 patients met the inclusion criteria. These patients had a confirmed diagnosis of congenital, developmental, or idiopathic scoliosis based on clinical examination and MRI findings. The study included individuals with lower back pain, radicular symptoms, limb numbness, weakness, and postural asymmetry. MRI was used to assess spinal curvature and identify underlying vertebral and neural axis anomalies. Data were collected regarding demographic characteristics and clinical symptoms.*

Results: *Of the 100 patients included, 52% were female and 48% were male. MRI confirmed 40% of cases as congenital scoliosis, 40% as developmental scoliosis, and 20% as idiopathic scoliosis. Back pain was the most commonly reported symptom, observed in 43% of patients. Numbness or tingling was present in 30% of patients.*

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Radiculopathy of the lower limbs occurred in 21%, while 17% had pain radiating to the upper limbs. Shortness of breath was the least reported symptom (6%). MRI findings also revealed associated abnormalities, including low-lying conus medullaris (39%), vertebral height reduction (47%), disc bulge (11%), and vertebral displacement (15%).

INTRODUCTION

A lateral spinal curvature with a Cobb angle of 10° or more is called scoliosis (1). An underlying congenital, developmental, or neurologic defect of the osseous or nervous system may be the cause of this aberrant curvature (2). Congenital, idiopathic, neuromuscular, and developmental scoliosis are additional categories for scoliosis according to its etiology. Low (up to 20°), moderate (21 to 35°), severe (36 to 40°), severe (41 to 50°), severe to very severe (51 to 55°), and very severe (56°) are the angular classifications based on the Cobb angle. According to the apex, scoliosis can occur in the thoracic (from disc T1-2 to disc T11-12), thoracolumbar (from T12 to L1), or lumbar regions of the body (disc L1-2). Additionally defined are double (S-shaped) and three-curve designs (3). The most common congenital abnormality of the spine is congenital scoliosis. Congenital curvatures result from abnormal vertebral development (failure of segmentation and/or creation) (4). Congenital scoliosis is thought to be caused by abnormalities that result from chromosomal abnormalities in the fetus during the development of the spine (5). Vertebral rotation, which is first noticed during the patient's growth and development and causes walking trouble, is proceeded by the scoliosis curve (6). Idiopathic scoliosis is a three-dimensional (3D) rotational curvature of the spine that emerges without a definite underlying cause and affects an estimated 2 to 4 percent of the general population, however, there have been reports of regional differences (7). Girls are more likely than boys to suffer scoliosis during the teenage growth spurt. Idiopathic scoliosis, which represents 80% of scoliosis cases, is the most frequent kind. Usually, patients present spinal deformity or, more likely, chest wall and back asymmetry and posterior chest wall prominence is the most outward manifestation of spinal curvature (8). With more significant scoliosis, adolescent girls sometimes notice a difference in their breast sizes. Other body characteristics may include shoulder asymmetry and overall posture imbalance in the coronal plane (9).

While not typically the presenting symptom, back pain is not unusual. Approximately one-quarter of patients with adolescent idiopathic scoliosis (AIS) present with back. A complete neurological history should include inquiries of weakness, sensory changes, problems of balance, gait and coordination, as well as bowel and bladder difficulties such as incontinence (10).

It is very important to assess the patient's clinical findings associated with the level of spine and its type because it provides a greater insight dynamics of management process.

Literature Review

Several studies have emphasized the clinical significance of MRI in identifying neural axis abnormalities in patients with scoliosis, especially those with idiopathic and congenital variants. Filiz Tuna et al. (2020) reported that while 76.7% of scoliosis patients had no overt neurological deficits, approximately 33.3% presented with pain, highlighting the need for comprehensive neurological assessment even in early or asymptomatic cases. Their study supports the role of MRI in detecting subtle pathologies such as disc anomalies or vertebral malformations that could explain clinical symptoms like numbness or radicular pain in scoliosis patients (3).

Similarly, Inoue et al. (2015) investigated the prevalence of neural axis malformations in 250 patients diagnosed with idiopathic scoliosis who were scheduled for spinal surgery. The MRI findings revealed that 18% of these patients had

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underlying neurological anomalies, including syringomyelia, Chiari malformations, and low-lying conus medullaris. These abnormalities were often associated with symptoms such as back pain, gait disturbance, or balance issues. The study underscores the diagnostic value of MRI in planning the surgical and clinical management of scoliosis patients by detecting occult neurological involvement (17).

Material & Methods:

This descriptive, cross-sectional study was conducted at Ghurki Trust and Teaching Hospital, Lahore. A total of 150 patients presenting with signs and symptoms suggestive of spinal scoliosis were initially evaluated. Out of these, 100 patients met the inclusion criteria and were selected using non-probability consecutive sampling.

The inclusion criteria were patients of any gender and age who presented with clinical features indicative of scoliosis and had the diagnosis confirmed by magnetic resonance imaging (MRI). Exclusion criteria included patients with a history of spinal trauma, spinal surgery, or other non-scoliotic spinal disorders such as tumors or infections.

Clinical Assessment and Imaging:

All patients underwent a thorough clinical examination to evaluate symptoms such as back pain, numbness, tingling sensations, radiating limb pain, muscle weakness, and postural asymmetry (e.g., uneven shoulders or hips). The diagnosis of scoliosis was confirmed through MRI, which also enabled classification into congenital, developmental, or idiopathic scoliosis. Additionally, MRI was used to detect associated structural anomalies such as disc bulges, vertebral displacement, vertebral height reduction, and low-lying conus medullari.

Data Collection and Variables:

Data were collected using a structured clinical assessment form. The variables recorded included demographic information (age, gender), scoliosis type (congenital, developmental, idiopathic), and associated clinical manifestations (back pain, numbness or tingling, radiating upper/lower limb pain, shortness of breath). Imaging findings such as vertebral anomalies and neural axis abnormalities were also documented.

Statistical Analysis:

Data were entered and analyzed using SPSS version 26.0 Descriptive statistics were applied to summarize the frequency and percentage of each clinical manifestation and imaging finding. Results were tabulated to demonstrate the distribution of symptoms among different scoliosis types. Graphical representation was used to depict age and gender distribution.

Results:

A total of 100 patients diagnosed with spinal scoliosis using MRI were included in this study. The gender distribution showed a slight female predominance, with 52% female and 48% male participants. The majority of patients were diagnosed with either congenital scoliosis (40%) or developmental scoliosis (40%), while 20% had idiopathic scoliosis. Some overlap existed due to multiple contributing factors in certain patients.

Variable	**Percentage** (%)
Gender	
Male	48%
Female	52%
Demographics	
Congenital	40%
Developmental	40%

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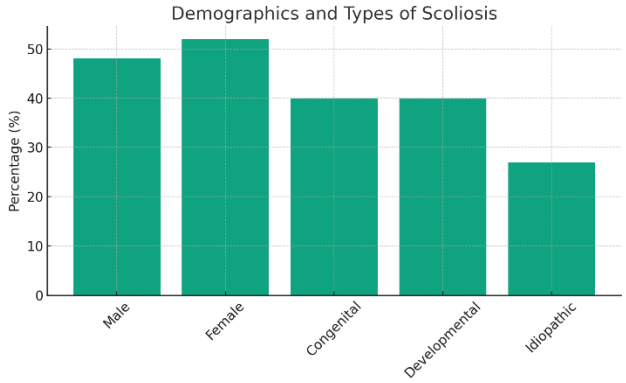
Variable	Percentage (%)
Idiopathic	20%

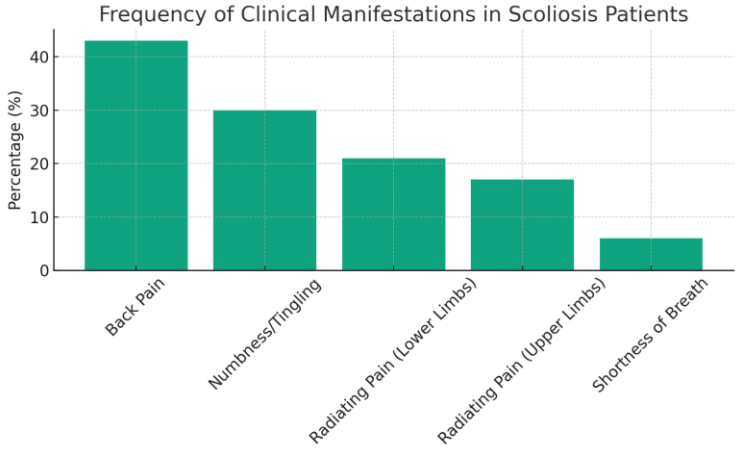
Table 1: Demographic Characteristics and Types of Scoliosis (n=100)



The most frequently reported clinical manifestation was back pain, observed in 43% of patients. Numbness or tingling was the second most common symptom, affecting 30% of patients. Lower limb radiculopathy was present in 21%, while 17% experienced radiating pain in the upper limbs. Shortness of breath was the least reported symptom, seen in 6% of cases.

Clinical Manifestation	Percentage (%)
Back Pain	43%
Numbness/Tingling	30%
Radiating Pain (Lower Limbs)	21%
Radiating Pain (Upper Limbs)	17%
Shortness of Breath	6%

Table 2: Frequency of Clinical Manifestations in Scoliosis Patients



MRI imaging also revealed associated anatomical abnormalities. The most frequent finding was reduction in vertebral body height (47%), followed by low-lying conus medullaris (39%), vertebral displacement (15%), and disc bulges (11%).

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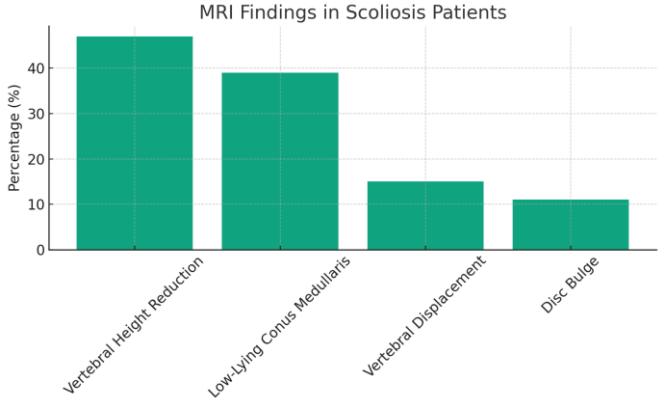
MRI Finding	Percentage (%)
Vertebral Height Reduction	47%
Low-Lying Conus Medullaris	39%
Vertebral Displacement	15%
Disc Bulge	11%

Table 3: MRI Findings among Patients with Spinal Scoliosis



Discussion:

Scoliosis deformities are a major cause of disability, economic hardship, and disease worldwide and ultimately cause significant complications. They are caused by the patient having clinical manifestation and a provisional diagnosis of scoliosis, genetic problems, family history, cerebral pulse, etc. (11). The most common conditions include degenerative disc disease, height reduction, vertebral displacement, and convexity, as a result of these conditions, the patient feels back pain, numbness, and other neurological symptoms. Much research has been done to evaluate scoliosis on MRI to rule out causes of body pain, radiating shoulder pain, body weakness, and arm numbness. The results of our research were consistent with other studies. To our knowledge, few studies have evaluated whole spine MRI findings. According to Filiz Tuna et.al. in (2020), ten patients (33.3%) complained of pain, while 23 patients (76.7%) had no neurological deficit and seven (23.3%) had hypoesthesia (12,13). Gerardo Olivella et.al., in (2020) The presence of underlying pathology was detected by MRI in 54 painful AIS patients (35.5%). Isolated syringomyelia was the only nerve axis abnormality found in 6 patients (3.9%) (14). While in our study we saw that the most common abnormalities that are affected due to scoliosis are a reduction in body height by 47%, a low-lying cone by 39%, and 40% of patients were congenital. A decrease in body height causes disc bulging, spinal stenosis causes back pain and body weakness. The upper and lower limb radiculopathy is 17% and 21% respectively. Considering the results of previously conducted studies, the aim of this study was to find the results in coherence with the previous ones in order to reduce the investigation time and provide the right way for diagnosis which can lead to early treatment (15,16).

According to Inoue M et.al., in (2015) conducted a study to investigate the prevalence of neural axis malformations and the clinical significance of MRI in the evaluation of patients with idiopathic scoliosis undergoing surgery (17,18). A total of 250 patients classified as having “idiopathic” scoliosis at first presentation and admitted for spine surgery were evaluated. All patients were examined for neural axis abnormalities by MRI. The presence of neurological symptoms and abnormal

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neurological signs were also examined before and after surgery. Neurological complications during scoliosis surgery were reviewed in patients with neural axis abnormalities. There were 44 (18%) patients (13 men and 31 women) who had neural axis abnormalities on MRI, including syringomyelia with Chiari malformation in 22 patients, syringomyelia with tonsillar ectopia in 2, Chiari malformation in 13, tonsillar ectopia in 6, and low conus medullaris in. During our study, we found that 52 were females and 48 were males, and 22% cases were diagnosed with diastematomyelia. 39% cases were observed with low-lying conus, 47% were diagnosed with the reduction in body height, 11% with a disc bulge, and 15% with the displacement of vertebrae (19,20).

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