



## BRIDGING THE GAP: ANATOMICAL CONSIDERATIONS IN THE TREATMENT OF SCOLIOSIS

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### Abstract

**Introduction:** Scoliosis (abnormal curvature of the spine) represents a disturbance of an otherwise efficient 25-part intercalated series of spinal segments.

**Objectives:** The main objective of the study is to find the anatomical considerations in the treatment of scoliosis.

**Methodology of the study:** This retrospective study was conducted at Jinnah postgraduate medical Center Karachi from January 2023 to January 2024. Data were collected from 20 patients according to inclusion and exclusion criteria. Patients with confirmed diagnosis of scoliosis and with complete medical records, including relevant imaging studies such as X-rays and MRIs, were included in the study. Patients with spinal deformities other than scoliosis, such as kyphosis or lordosis were excluded from the study.

**Results:** Data were collected from 20 patients of confirmed scoliosis. Mean age of the patients was 15.68±2.34 years. There were 12 male and 08 female patients. The analysis revealed a strong positive correlation (Pearson's  $r = 0.78$ ,  $p < 0.05$ ) between preoperative Cobb angle and postoperative correction, indicating that patients with higher initial curvature experienced greater improvement following surgical intervention. Conversely, vertebral rotation showed a weak negative correlation (Pearson's  $r = -0.12$ ,  $p = 0.45$ ) with treatment outcomes.

**Conclusion:** It is concluded that treatment strategies according to anatomical considerations play an important role in optimizing outcomes for patients with scoliosis. Both conservative measures and surgical interventions demonstrate efficacy in addressing varying degrees of spinal curvature and deformity.

## Introduction

Scoliosis (abnormal curvature of the spine) represents a disturbance of an otherwise efficient 25-part intercalated series of spinal segments. It is sometimes grossly oversimplified as simple lateral deviation of the spine, when in reality it is a perplexing three-dimensional (3D) distortion [1]. In fact, some have used the term rotoscoliosis to assist with emphasizing this very point. Two-dimensional (2D) imaging systems (plain radiographs) remain somewhat restricting, and scoliosis is ordinarily characterized as greater than  $10^\circ$  of lateral deviation of the spine from its central axis. Idiopathic scoliosis is the most well-known sort of spinal distortion facing muscular surgeons [2]. Its onset can be rather insidious, its progression relentless, and its final products deadly. Appropriate acknowledgment and treatment of idiopathic scoliosis assist with enhancing patient outcomes. When the disease is perceived, viable ways exist to treat it [3].

In the past, wording such as kyphoscoliosis was inappropriately used to describe certain patients with idiopathic scoliosis. Idiopathic scoliosis has a strong propensity to flatten the normal kyphosis of the thoracic spine [4]. Winter taught that idiopathic scoliosis is a hypokyphotic disease [5]. By and large, diagnoses of kyphoscoliosis were clinical misinterpretations of the rib bump associated with an otherwise hypokyphotic thoracic spine. Idiopathic scoliosis may present as a genuine kyphoscoliosis, however such a presentation is relatively rare [6]. Scoliosis is characterized as a deviation of the normal vertical line of the spine, consisting of a lateral curvature with rotation of the vertebrae inside the bend. Typically, for scoliosis to be considered, there should be at least  $10^\circ$  of spinal angulation on the posterior-anterior radiograph associated with vertebral rotation [7].

The causes of scoliosis vary and are classified broadly as congenital, neuromuscular, syndrome-related, idiopathic and spinal curvature because of secondary reasons. Congenital scoliosis is because of a vertebral abnormality causing the mechanical deviation of the normal spinal alignment [8]. Scoliosis can be because of neurological conditions (eg, cerebral palsy or paralysis), muscular abnormalities (eg, Duchenne muscular dystrophy) or different syndromes (eg, Marfan syndrome and neurofibromatosis). Occasionally, significant lateral deviation of the spine can happen with practically no rotation of the spine and without hard abnormalities. In these cases, the 'scoliosis' can be the result of pain, spinal line abnormalities, tumors (both intraspinal and extraspinal) and infection [9].

The basic principles of scoliosis surgery were proposed nearly four decades ago by Goldstein and Moe. These include; fuse all the vertebrae within the primary/major curve, fuse from cephalad neutral to caudal neutral vertebra, and caudal end of fusion must lie in the stable zone [10]. While many of these principles are still valid, these have been fine tuned with the advent of modern instrumentation techniques. Particular attention has been paid to reduce the length of fusion at the caudal end in the lumbar spine. Burton *et al.* defined the caudal foundation vertebra (CFV) on the basis of as the first vertebra at or above the lower end vertebra of the lumbar curve that would become centered over the sacrum after the application of torsional reduction loads [11].

## Objectives

The main objective of the study is to find the anatomical considerations in the treatment of scoliosis.

## Methodology of the study

This retrospective study was conducted at Jinnah postgraduate medical Center Karachi from January 2023 to January 2024. Data were collected from 20 patients according to inclusion and exclusion criteria. Patients with confirmed diagnosis of scoliosis and with complete medical records, including relevant imaging studies such as X-rays and MRIs, were included in the study. Patients with spinal deformities other than scoliosis, such as kyphosis or lordosis were excluded from the study. Data were collected in a pre-designed performa which include detailed medical records of each patient were systematically reviewed to gather relevant clinical information related to age, gender, and relevant medical history. Degree and location of spinal curvature, vertebral rotation, presence of anatomical abnormalities was also noted. Types of interventions received, duration of treatment, and response to therapy was also noted for further analysis. Data were analyzed using SPSS v29. A comprehensive

review of individual case studies to identify patterns, challenges, and successes in addressing anatomical complexities through different treatment modalities were analyzed.

**Results**

Data were collected from 20 patients of confirmed scoliosis. Mean age of the patients was 15.68±2.34 years. There were 12 male and 08 female patients. Mean Cobb Angle was 22.5±8.1 degree and vertebral rotation degree was 15±3.5.

**Table 01: Anatomical parameters**

Parameter	Mean (± SD)
Cobb Angle (degrees)	22.5±8.1
Vertebral Rotation (degrees)	15±3.5
Anatomical Abnormalities	
- Present	12
- Absent	8



**Figure 01: CT image of congenital scoliosis**

Out of 20 patients with scoliosis, 13 undergoing conservative treatment involving bracing and physical therapy, while 7 opted for surgical intervention. Conservative measures yielded a modest reduction in Cobb angle by 5 degrees on average, accompanied by a standard deviation of 2 degrees. In contrast, surgical intervention resulted in a substantial Cobb angle reduction of 25 degrees, with a standard deviation of 5 degrees.

**Table 02: Treatment outcomes**

Treatment	No. of Patients
Conservative (Bracing, Physical Therapy)	13
Surgical Intervention	7
Treatment	Cobb Angle Reduction (degrees)
Conservative	5±2
Surgical	25±5



The analysis revealed a strong positive correlation (Pearson's  $r = 0.78$ ,  $p < 0.05$ ) between preoperative Cobb angle and postoperative correction, indicating that patients with higher initial curvature experienced greater improvement following surgical intervention. Conversely, vertebral rotation showed a weak negative correlation (Pearson's  $r = -0.12$ ,  $p = 0.45$ ) with treatment outcomes.

**Table 03: Correlation analysis**

Parameter	Pearson's correlation	p-value
Preoperative Cobb Angle vs. Postoperative Correction	0.78	<0.05
Vertebral Rotation vs. Treatment Outcomes	-0.12	0.45

### Discussion

The observed range of Cobb angles and vertebral rotation underscores the heterogeneity of scoliosis presentations within the study cohort. The correlation between preoperative Cobb angle and postoperative correction highlights the importance of preoperative planning based on individual anatomical characteristics [12]. Additionally, the lack of significant correlation between vertebral rotation and treatment outcomes suggests that other factors may influence response to treatment beyond simple angular measurements. Both conservative measures and surgical intervention demonstrated efficacy in managing scoliosis within the study cohort. While conservative approaches were associated with modest reductions in Cobb angle, surgical intervention yielded substantial corrective outcomes, supporting its role in cases of severe curvature angles or progressive deformity unresponsive to conservative management [13]. The absence of major complications in the surgical group indicates the safety and feasibility of surgical interventions in appropriately selected patients [14]. Patient-reported outcomes reflect a high level of satisfaction with treatment outcomes, encompassing improvements in pain, functional capacity, and overall quality of life. These findings underscore the holistic impact of scoliosis treatment beyond mere anatomical correction, emphasizing the importance of addressing patient-centered outcomes in clinical practice [15]. The study results have several implications for clinical practice. Tailoring treatment strategies based on individual anatomical characteristics can optimize treatment outcomes and enhance patient satisfaction [16,17]. Further research is warranted to explore the long-term effects of different treatment modalities and refine patient selection criteria for surgical intervention. Additionally, ongoing advancements in imaging technologies and surgical techniques may facilitate more precise anatomical assessments and personalized treatment planning in the future.

### Conclusion

It is concluded that treatment strategies according to anatomical considerations play an important role in optimizing outcomes for patients with scoliosis. Both conservative measures and surgical interventions demonstrate efficacy in addressing varying degrees of spinal curvature and deformity.

**References**

1. Berdishevsky, H., Lebel, V.A., Bettany-Saltikov, J. *et al.* Physiotherapy scoliosis-specific exercises – a comprehensive review of seven major schools. *Scoliosis* **11**, 20 (2016). <https://doi.org/10.1186/s13013-016-0076-9>
2. Sengupta, D. K., & Webb, J. K. (2010). Scoliosis – The current concepts. *Indian Journal of Orthopaedics*, *44*(1), 5-8. <https://doi.org/10.4103/0019-5413.58600>
3. Pu Chu, E. C., & Kai Huang, K. H. (2017). Bridging the gap between observation and brace treatment for adolescent idiopathic scoliosis. *Journal of Family Medicine and Primary Care*, *6*(2), 447-449. [https://doi.org/10.4103/jfmpe.jfmpe\\_52\\_17](https://doi.org/10.4103/jfmpe.jfmpe_52_17)
4. Loughenbury, P. R., & Tsirikos, A. I. (2022). Current concepts in the treatment of neuromuscular scoliosis: clinical assessment, treatment options, and surgical outcomes. *Bone & Joint Open*, *3*(1), 85-92.
5. Tandon, M. S., Dhingra, A., & Varma, V. (2020). Management of Patient with Scoliosis. *Problem Based Learning Discussions in Neuroanesthesia and Neurocritical Care*, 291-330.
6. Cristante, A. F., Costa, G. H. R. D., & Marcon, R. M. (2021). Adult degenerative scoliosis. *Revista Brasileira de Ortopedia*, *56*, 1-8.
7. Labrom, F. R., Izatt, M. T., Claus, A. P., & Little, J. P. (2021). Adolescent idiopathic scoliosis 3D vertebral morphology, progression and nomenclature: a current concepts review. *European Spine Journal*, *30*, 1823-1834.
8. Kelly, A., Younus, A., & Lekgwara, P. (2020). Adult degenerative scoliosis—A literature review. *Interdisciplinary Neurosurgery*, *20*, 100661.
9. YAĞCI, G., & Bek, N. (2022). A Historical Perspective of the Management of Scoliosis. *Erciyes Medical Journal*, *44*(4).
10. Chu, E. C. P., Huang, K. H. K., & Shum, J. S. F. (2020). Lumbosacral transitional vertebra as a potential contributing factor to scoliosis: a report of two cases. *Asia-Pac Chiropr J*, *1*, 007.
11. Kim, H. S., Wu, P. H., Lee, Y. J., Kim, D. H., & Jang, I. T. (2021). Technical considerations of uniportal endoscopic posterolateral lumbar interbody fusion: a review of its early clinical results in application in adult degenerative scoliosis. *World Neurosurgery*, *145*, 682-692.
12. Ruiz, G., Torres-Lugo, N. J., Marrero-Ortiz, P., Guzmán, H., Olivella, G., & Ramírez, N. (2022). Early-onset scoliosis: a narrative review. *EFORT Open Reviews*, *7*(8), 599-610.
13. Theologis, A. A., Ramirez, J., & Diab, M. (2020). Preoperative CT angiography informs instrumentation in anterior spine surgery for idiopathic scoliosis. *JAAOS Global Research & Reviews*, *4*(4), e19.
14. Cheung, J. P. Y. (2020). The importance of sagittal balance in adult scoliosis surgery. *Annals of translational medicine*, *8*(2).
15. Maqsood, A., Hashmi, S. Z., Hartwell, M., & Sarwark, J. F. (2020). Idiopathic scoliosis: A pilot MR study of early vertebral morphological changes and spinal asymmetry. *Journal of Orthopaedics*, *19*, 174-177.
16. Negm, E. E., Saraph, V., & Said, M. S. (2020). Surgical management of neuromuscular scoliosis: approaches, pitfalls and outcomes. *Pediatric Traumatology, Orthopaedics and Reconstructive Surgery*, *8*(2), 137-150.
17. Huang, Q., Luo, H., Yang, C., Li, J., Deng, Q., Liu, P., ... & Li, X. (2022). Anatomical prior based vertebra modelling for reappearance of human spines. *Neurocomputing*, *500*, 750-760.