

Navigating Complex Thoracic Spinal Deformity: A Multifaceted Analysis of Life Quality Impacts and Emerging Therapeutic Approaches - Case Report of a 47-Year-Old Man

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Abstract

This case report presents a 47-year-old male with severe thoracic scoliosis measuring 80 degrees and significant kyphosis. The patient reported chronic back pain, restricted mobility, compromised cardiopulmonary function, low self-esteem, and limited activities. Radiographs confirmed the deformity without congenital anomalies. Adult spinal deformities pose challenges due to skeletal maturity. Non-operative management has limited effectiveness for severe cases. Surgery risks must be weighed against benefits. Novel understandings of spinal biomechanics may enable less invasive corrections. The profound impacts of deformity on quality of life were demonstrated. A comprehensive, individualized approach is needed. Ongoing research may improve outcomes and redefine care standards.

Keywords: Congenital abnormalities, kyphosis, radiography, scoliosis

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INTRODUCTION

Significant spinal deformities of the thoracic region pose a considerable challenge for orthopedic surgeons, especially when presenting in adult patients.^[1] Such conditions provide a notable case study to investigate the nuanced interrelationship between skeletal development, physiological tolerance, and the feasibility of restorative treatment. Thoracic spinal deformity in mature patients is a complex problem^[2] as the fusion of vertebral growth plates limits the degree of realignment possible.^[3] In addition, the rigidity imparted by age also affects tolerability of manipulative maneuvers.^[4] Therefore, evaluating an individual's skeletal maturity and physical resiliency is paramount to determine the viability and appropriate approach for correction. This multifaceted interplay between developmental factors, physiological constraints, and therapeutic opportunities renders

thoracic spinal deformity in adults a unique scenario to explore the boundaries of orthopedic remediation for spinal deformities across the lifespan.^[5] Adults presenting with severe thoracic spinal deformities constitute a notable patient group residing at a pivotal juncture. While past skeletal plasticity of youth, the full ramifications of advanced aging have not manifested. Thus, occupying a distinct clinical context regarding therapeutic options. Growth plate closure halts malleability, yet age-related inflexibility remains incipient.^[6] Consequently, treatment feasibility exceeds that of geriatric patients.^[7] However, spinal manipulation proves more precarious versus younger individuals owing to diminished accommodation within rigid vertebrae. Comprehensive evaluation of each patient's anatomical and physiological particulars optimizes risk-benefit balancing to

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select the most judicious approach.^[8] This intriguing transitional phase experienced by adults harboring deformities represents an opportunity to refine longitudinal management paradigms for such conditions.^[9] Overall, a balanced appraisal respects this population's positioning between formative flexibility and impending frailty [Figure 1].^[10]

The etiology of thoracic spinal deformities is diverse, ranging from congenital malformations to degenerative processes, neuromuscular disorders, or idiopathic causes. In adults, these deformities may represent a progression from adolescent onset or develop *de novo* due to various pathological processes. The severity of such deformities is typically quantified through radiographic measurements, such as the Cobb angle for scoliosis or the kyphotic angle for sagittal plane abnormalities. However, the impact on the patient's overall health and functionality transcends mere numerical values, necessitating a holistic approach to assessment and treatment. Recent advancements in our understanding of spinal biomechanics have led to exciting discoveries that challenge traditional perspectives on adult spinal deformities. Through innovative combinations of advanced imaging techniques and cutting-edge biomechanical modeling, researchers have begun to uncover previously unrecognized compensatory mechanisms within the thoracolumbar junction. These mechanisms, which appear to be active in certain adult populations, offer potential windows of opportunity for less invasive corrective strategies. Such findings not only shed new light on the natural history of spinal deformities but also pave the way for revolutionary treatment approaches that could dramatically improve outcomes and quality of life for affected individuals.^[11] The implications of severe thoracic spinal deformity on quality of life are profound and multifaceted. Physical manifestations often include chronic pain, restricted mobility, and compromised cardiopulmonary function due to alterations in thoracic cavity volume and mechanics. The psychosocial impact is equally significant, with patients reporting decreased self-esteem, social isolation, and limitations in work and recreational activities. Moreover, the potential for neurological compromise due to spinal cord or nerve root compression adds another layer of complexity to the clinical picture [Figure 2].

Treatment strategies for severe thoracic spinal deformity in adults must be meticulously tailored to each patient, considering the specific characteristics of the deformity, the individual's symptoms and functional limitations, and their overall health status. Non-operative management, including physical therapy, bracing, and pain management techniques, often yields limited results in correcting severe deformities in adults. Surgical intervention, while offering more substantial correction, carries significant risks and requires careful evaluation of the risk-benefit ratio. Surgical options encompass a range of techniques, from posterior spinal fusion with instrumentation to more complex procedures such as vertebral column resection for the most severe and rigid curves. The selection of the appropriate surgical approach is influenced by multiple factors, including curve flexibility, the presence of coronal and sagittal imbalance, and the patient's overall health status. Recent advancements in surgical planning, including 3D imaging and computer-assisted navigation, have enhanced the precision and safety of these complex procedures. The management of severe thoracic spinal deformity in adults presents a unique set of challenges that demand a comprehensive and individualized approach. The interplay between deformity severity, quality of life impact, and available treatment options requires careful consideration. As our understanding of spinal biomechanics continues to evolve, so too does our ability to address these complex cases. Ongoing research into compensatory mechanisms and adaptive responses in adult spinal deformities opens up new avenues for investigation and treatment, potentially revolutionizing the field of adult spinal deformity correction. The case report sets the stage for an in-depth exploration of severe thoracic spinal deformity in adults, its implications for quality of life, and the evolving landscape of treatment strategies. By delving into the complexities of this condition, we aim to contribute to the existing body of knowledge and inspire further research that could ultimately lead to improved patient outcomes and redefined standards of care in adult spinal deformity management.^[12]

Informed consent

Written informed consent was obtained from the patient for publication of this case report and any accompanying images.

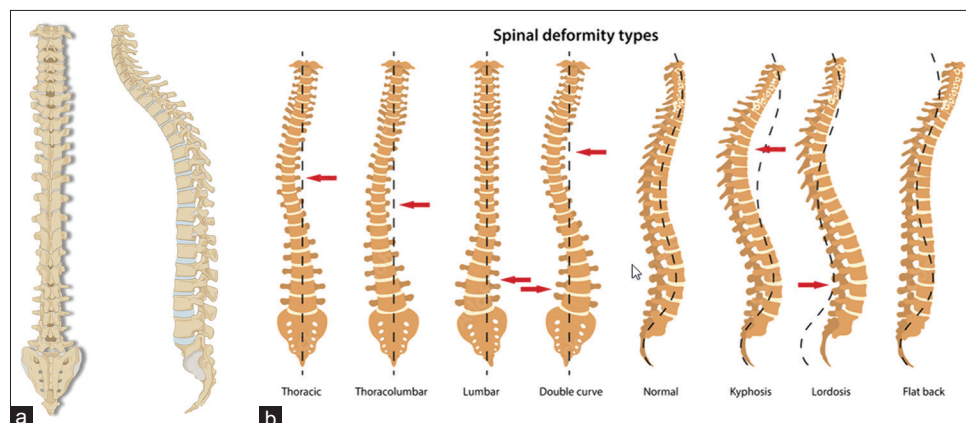


Figure 1: (a) Illustrates normal spinal anatomy, while (b) showcases various spinal deformities

The patient understood that details relating to their case would be published in a medical journal, including relevant history, images such as X-rays, and details of treatment and any complications.

CASE REPORT

A 47-year-old male patient presented to the radiology department at Jey Clinic, Isfahan, Iran, with complaints of severe back deformity, chronic pain, and dyspnea. The patient's medical history was unremarkable for spinal conditions during childhood or adolescence, suggesting late-onset or rapidly progressive adult scoliosis. Upon physical examination, the patient exhibited a pronounced kyphosis and severe thoracic scoliosis. The deformity was visibly apparent, with asymmetry of the shoulders and trunk, and a prominent rib hump on the convex side of the spinal curve. The patient's posture was notably poor, with a forward-leaning stance and visible difficulty in maintaining an upright position. The patient reported chronic back pain, particularly in the thoracic region, along with exertional dyspnea and difficulty with prolonged physical activities. Additionally, he experienced fatigue, decreased endurance, and cardiovascular symptoms such as occasional palpitations and chest discomfort. The patient described a significantly reduced quality of life, reporting difficulty in performing daily activities, sleep disturbances due to discomfort, social withdrawal, self-consciousness about his appearance, and an inability to participate in previously enjoyed recreational activities. Radiological examination was performed, including full-spine standing X-rays in anteroposterior and lateral views. The imaging studies revealed extreme thoracic scoliosis with a Cobb angle measuring 80 degrees [Figures 3 and 4], significant rotation of the vertebrae, and rib cage deformity with a prominent rib hump. The severity of the patient's thoracic spinal deformity was quantified using the standard Cobb angle measurement technique. To calculate the Cobb angle, the radiologist first identified the uppermost and lowermost vertebrae defining the curvature of the scoliotic spinal curve on the anteroposterior radiograph. Tangent lines were then drawn along the superior endplate of the upper vertebra and the inferior endplate of the lower vertebra. The angle formed between these two lines at their point of intersection indicated the degree of spinal curvature. In this case, the patient demonstrated an angle of 80 degrees in the main thoracic curve, classifying it as an extremely severe deformity according to commonly used classification systems. No congenital vertebral anomalies were observed, though mild degenerative changes in the intervertebral discs were noted (red arrow in Figure 3). This comprehensive clinical presentation provides a detailed overview of the patient's condition, emphasizing the severity of the spinal deformity and its wide-ranging impacts on the patient's health and quality of life. The information gathered from clinical examination, patient history, and diagnostic imaging forms the foundation for discussing treatment strategies and management options in the subsequent sections of the case report.

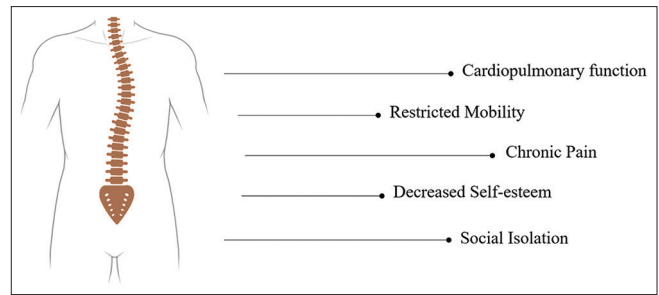


Figure 2: This figure illustrates the multiple complications of extreme thoracic scoliosis, including impaired cardiopulmonary, psychological issues, and significant postural deformities. These complications highlight the extensive impact of severe spinal curvature on overall health and well-being



Figure 3: Anteroposterior view of a 47-year-old male patient, demonstrating an 80-degree thoracic scoliosis and significant kyphotic deformity

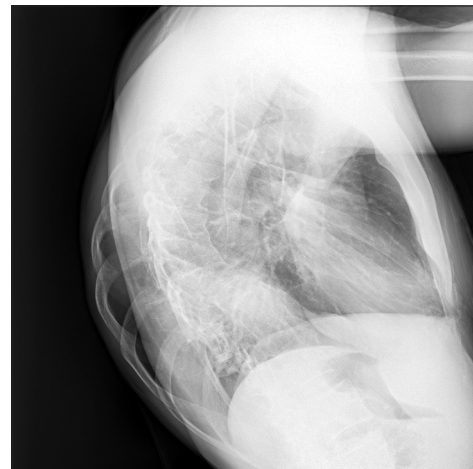


Figure 4: Lateral thoracic radiograph demonstrating severe costal deformity and pronounced thoracic kyphosis

DISCUSSION

The case presented herein underscores the multifaceted challenges associated with the management of severe thoracic

spinal deformity in an adult patient. The 47-year-old male patient's condition, characterized by an 80-degree thoracic scoliosis and significant kyphotic deformity, exemplifies the complex interplay between skeletal maturity, physiological resilience, and the potential for corrective intervention in this patient population. Adult spinal deformities, such as the one described, often represent a progression from adolescent-onset conditions or develop *de novo* due to various pathological processes, including degenerative changes, neuromuscular disorders, or idiopathic causes.^[13] The severity of the deformity, as quantified by radiographic parameters such as the Cobb angle, is a crucial factor in determining the appropriate treatment approach. However, the impact of these deformities on the patient's overall health, functionality, and quality of life extends far beyond the numerical values, necessitating a comprehensive, patient-centered assessment.^[14] In the present case, the patient's clinical presentation highlights the profound physical, psychological, and social consequences of severe thoracic spinal deformity. Chronic back pain, restricted mobility, and compromised cardiopulmonary function due to thoracic cavity volume and mechanics alterations were among the primary concerns reported by the patient.^[15] The psychosocial impact was equally significant, with the patient experiencing decreased self-esteem, social isolation, and limitations in work and recreational activities. The potential for neurological compromise secondary to spinal cord or nerve root compression further added to the complexity of the patient's clinical picture. Tailoring the treatment strategy to the individual patient's needs is crucial in managing severe thoracic spinal deformity in adults. Non-operative management, including physical therapy, bracing, and pain management techniques, often yields limited results in correcting substantial deformities in this patient population. Surgical intervention, while offering more substantial deformity correction, carries significant risks and requires a careful evaluation of the risk-benefit ratio.

The surgical options for adult thoracic spinal deformity range from posterior spinal fusion with instrumentation to more complex procedures, such as vertebral column resection, for the most severe and rigid curves. The selection of the appropriate surgical approach is influenced by multiple factors, including curve flexibility, the presence of coronal and sagittal imbalance, and the patient's overall health status. Recent advancements in surgical planning, including 3D imaging and computer-assisted navigation, have enhanced the precision and safety of these complex procedures. Ongoing research into compensatory mechanisms and adaptive responses in adult spinal deformities opens up new avenues for investigation and treatment, potentially revolutionizing the field of adult spinal deformity correction. These emerging insights into the thoracolumbar junction's biomechanical adaptations may offer opportunities for less invasive corrective strategies, ultimately improving outcomes and quality of life for affected individuals. The comprehensive assessment and multidisciplinary management approach employed in this case exemplify the

critical importance of a holistic and individualized approach to the care of patients with severe thoracic spinal deformities. By delving into the complexities of this condition and exploring the evolving treatment landscape, this case report aims to contribute to the existing body of knowledge and inspire further research that could lead to enhanced patient outcomes and redefined standards of care in adult spinal deformity management.

CONCLUSION

This case highlights the multifaceted challenges in managing severe thoracic spinal deformity in an adult patient. The 47-year-old male's condition, characterized by an 80-degree thoracic scoliosis and significant kyphosis, demonstrates the complex interplay between skeletal maturity, physiological resilience, and the potential for corrective intervention. The profound physical, psychological, and social impacts of this deformity, as evidenced by the patient's clinical presentation, underscore the need for a comprehensive, patient-centered approach to assessment and treatment. Chronic pain, restricted mobility, compromised cardiopulmonary function, decreased self-esteem, and limited work and recreational activities were among the debilitating effects. Tailoring the treatment strategy to the individual is crucial as non-operative management often yields limited results in correcting substantial deformities in adults. Surgical intervention, while offering more substantial correction, carries significant risks and requires careful evaluation of the risk-benefit ratio. Ongoing research into compensatory mechanisms and adaptive responses in adult spinal deformities may open new avenues for less invasive corrective strategies, potentially improving outcomes and quality of life. The comprehensive, multidisciplinary approach employed in this case exemplifies the importance of an individualized, holistic management strategy. This case report aims to contribute to the existing knowledge and inspire further research to enhance patient outcomes and redefine standards of care in adult spinal deformity management.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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