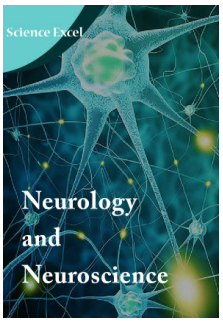
Neurology & Neuroscience

Case Report



Scheuermann's Kyphosis: Case Series and Literature Review

Pedro Nogarotto Cembraneli[1], Julia Brasileiro de Faria Cavalcante[1], Italo Nogarotto Cembraneli[2], Gabriel Ambrogi[3], Renata Brasileiro de Faria Cavalcante[1], José Edison da Silva Cavalcante (PhD)[1], Leonardo Taveira Lopes[4], Marcos Daniel Xavier[1], Vitor Cesar Machado[1], Rodrigo Correia de Alcântara[1], Alessandro Fonseca Cardoso[1], Chrystiano Fonseca Cardoso[1]

[1]Department of Neurosurgery, Hospital of Neurology Santa Mônica, Goiânia, GO, Brazil
[2]Department of Medicine, University Center of Mineiros, Mineiros, GO, Brazil
[3]Department of Orthopedics and Traumatology, Municipal University Hospital of Taubaté, Taubaté, SP, Brazil
[4]Department of Radiology, Hospital of Neurology Santa Mônica, Goiânia, GO, Brazil

*Correspondence
Pedro Nogarotto Cembraneli
Department of Neurosurgery, Hospital of Neurology Santa Mônica, Goiânia, GO, Brazil
E-mail: Email: pedrocembranelli@hotmail.com

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Abstract

Scheuermann's Kyphosis (SK) is a progressive spinal deformity characterized by abnormal thoracic curvature, with vertebral bodies displaying a wedge-shaped structure. It commonly affects adolescents during growth, leading to chronic pain, aesthetic changes, and functional limitations in severe cases. Early diagnosis and appropriate treatment are crucial to prevent deformity progression and minimize long-term complications. The prevalence of SK ranges from 0.4% to 8%, with genetic and biomechanical factors thought to play a central role in its development. This study reviews the diagnostic and therapeutic approaches for SK, focusing on updated guidelines from major spine societies, including the Brazilian Spine Society (SBC), North American Spine Society (NASS), and European Spine Society (ESS). The findings highlight regional differences in management strategies, with the SBC emphasizing early diagnosis and conservative treatment, the NASS advocating a multidisciplinary approach with surgical intervention for severe cases, and the ESS promoting a cautious approach with an emphasis on pain management and long-term complications prevention. Three clinical cases of surgical intervention are presented, showing successful outcomes following spinal fusion procedures. The study underscores the importance of individualized treatment, incorporating both conservative and surgical options based on the severity and progression of the deformity. Future research is needed to further refine treatment protocols and improve patient outcomes.

Introduction

Scheuermann's Kyphosis (SK) is a spinal deformity characterized by abnormal curvature in the thoracic region, with vertebral bodies having a wedge-shaped appearance, with the posterior portion being taller than the anterior part. This condition may result in chronic pain, aesthetic changes, and, in severe cases, significant functional restrictions. Early diagnosis and appropriate treatment are crucial to prevent the progression of deformity and minimize long-term complications [1,2].

The prevalence of SK in the general population is estimated to be between 0.4% and 8%, most commonly affecting adolescents during growth. Although the exact cause of the disease is unknown, genetic and biomechanical factors are believed to play an important role in its development [3,4]. The therapeutic approach is varied and depends on the severity of the deformity, the patient's age, and the symptoms presented [2,5].

Objective

This study aims to review diagnostic and therapeutic approaches for SK, with a focus on updated guidelines from major spine societies, such as the Brazilian Spine Society (SBC), North American Spine Society (NASS), and European Spine Society (ESS), discussing the different practices adopted and their implications for managing this pathology.

Methods

The research was conducted through a literature review of guidelines and recommendations from the mentioned spine societies, using peer-reviewed articles, textbooks, and clinical protocols to support best practices in diagnosing and managing SK. We also report a series of three cases treated by the neurosurgery team in the central-western region of Brazil.

Results

After the review, significant differences were

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identified in diagnostic and therapeutic approaches between the regions analyzed. In Brazil, the SBC emphasizes early diagnosis and regular monitoring, with a greater focus on conservative treatment, including physical therapy and the use of braces [6]. In the United States, the NASS recommends a multidisciplinary approach, with surgical interventions indicated for severe cases that are refractory to conservative treatment [7]. In Europe, the ESS adopts a more cautious approach, emphasizing pain management and the prevention of long-term complications through supervised exercise programs [8].

Data from PubMed and UpToDate support these guidelines, highlighting that conservative treatment is effective in most cases, but surgery may be necessary in more advanced cases or those causing significant symptoms [9,10]. The review revealed a high success rate in surgical interventions, such as spinal fusion, when appropriately indicated [11]. The prevalence of SK also showed regional variation, with North American studies suggesting a prevalence of up to 8%, while European data indicate a lower prevalence of around 4% [12,13].

Case series

Case 1

An 18-year-old male presented with severe thoracolumbar pain and visible deformity in the thoracic spine. X-rays and MRI showed a 67º curvature between T2 and T12, with the apex at T9. Due to intractable pain and significant aesthetic deformity, a posterior spinal fusion from T3 to L2 was performed. Post-surgery, the patient had a correction of the curvature to 36º, with significant pain reduction (Figure 1).

Case 2

A 27-year-old female presented with progressive thoracolumbar deformity and persistent pain. Imaging revealed a kyphosis of 108º between T2 and T12, with a remaining curvature of 81º after dynamic imaging. The chosen approach was an anterior thoracotomy with release from T9 to T11, followed by a posterior fusion from T2 to T12. Post-surgery, the curvature was corrected to 64º (Figure 2).

Case 3

A 33-year-old male had severe thoracolumbar pain and visible deformity. Imaging showed a kyphosis of 67º between T5 and

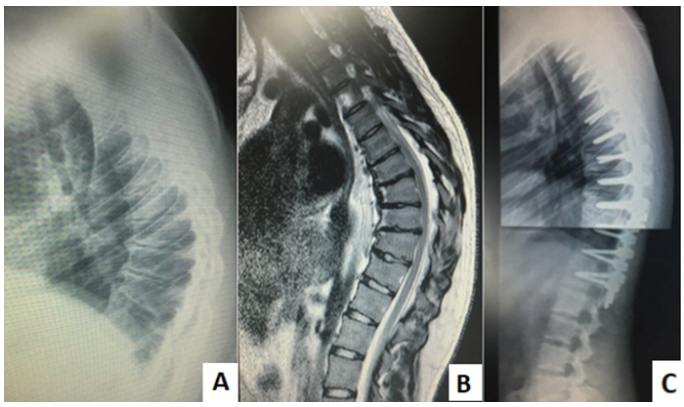

***Figure 1**. A – Lateral X-ray of the thoracic spine preoperative, showing a curvature from T2 to T12 of 67°. B – Preoperative MRI of the thoracic spine, showing multiple disc involvement and wedging of the thoracic vertebrae. C – Postoperative thoracolumbar X-ray following posterior spinal fusion, demonstrating correction of the curvature to 36°.*

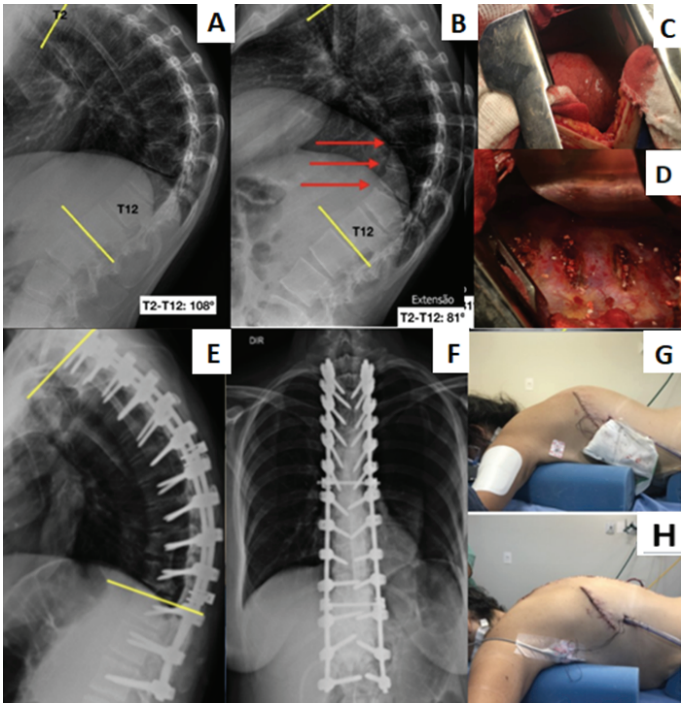

***Figure 2.** A – Preoperative X-ray of the thoracic spine from T2 to T12 showing a curvature of 108°. B – Residual curvature of 81° after dynamic testing. C – Intraoperative image of the thoracotomy. D – Intraoperative image after vertebral fusion release from T9 to T11. E – Postoperative lateral X-ray showing correction of the T2-T12 curvature to 64°. F – Postoperative anteroposterior X-ray showing spinal fusion from T2 to T12. G – Lateral image of the patient after anterior release of the T9 to T11 vertebrae. H – Lateral image of the patient after posterior spinal fusion, demonstrating significant correction of the kyphosis.*

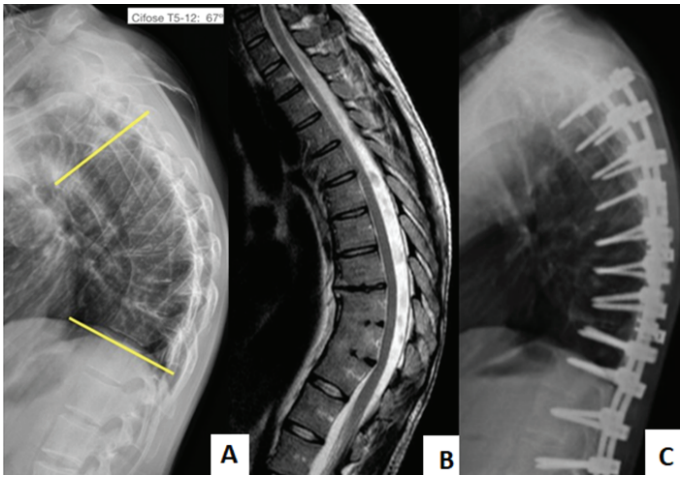

***Figure 3**. A – Preoperative lateral X-ray of the thoracic spine showing a 67° angle between T5 and T11. B – Preoperative MRI of the thoracic spine revealing multiple disc involvement and wedging of the vertebral bodies. C – Postoperative (6 months) lateral X-ray of the thoracic spine showing loosening of screws from T3 to T7 on the left side.*

T12 and failure of the previous anterior surgery between T9 and T11. He underwent surgery with thoracotomy for release from T8 to T11, followed by posterior fusion from T3 to L2, with correction to 40º. After 6 months, the patient experienced worsening pain and loosening of screws between T3 and T7 on the left, requiring further intervention for pseudoarthrosis treatment and screw replacement (Figure 3).

Discussion

SK is a progressive spinal deformity that primarily affects adolescents during growth and is characterized by thoracic hyperkyphosis associated with anterior wedging of the vertebrae. Although its etiology is multifactorial, genetic contributions and abnormalities in the vertebral endplates play a central role in the disease's development [14]. Early diagnosis is crucial for selecting the appropriate treatment and preventing long-term complications such as chronic pain and progressive deformity [15].

The etiology of SK is not fully understood, but studies suggest that genetic factors play an important role. Many cases show a family tendency, indicating hereditary predisposition. Additionally, biomechanical and environmental factors, such as repetitive stress on the spine during growth, may contribute to the disease's development. The hypothesis of genetic involvement is supported by studies linking the COL2A1 gene, which codes for type II collagen, a key component of bone and cartilage matrix [16]. The interaction between genetic and environmental factors, such as physical activities during adolescence, may be decisive in the disease's manifestation [17].

In the pathophysiology, the deformation of the thoracic vertebrae occurs due to disproportionate growth between the anterior and posterior parts of the vertebrae, leading to their wedge-shaped appearance. This process can be exacerbated by the formation of osteophytes and degenerative changes in the intervertebral discs. Changes in the shape of the vertebrae, combined with modifications in the disc structure, can lead to chronic pain and an increase in spinal curvature over time [18]. MRI studies have also shown early degeneration of intervertebral discs in patients with SK [19].

The diagnosis is primarily clinical and radiological. According to SBC guidelines, the initial diagnosis is based on a detailed clinical assessment and confirmation through radiological examinations, including flexion and extension X-rays. SBC recommends that for SK to be confirmed, the thoracic curvature should be greater than 45º, with at least three consecutive vertebrae showing an anterior deformity of more than 5º [6]. NASS also follows similar criteria, emphasizing the evaluation of curvature progression and factors that may indicate the need for early intervention, such as severe pain or aesthetic deformity [7]. ESS, on the other hand, suggests a more conservative approach, emphasizing regular radiological follow-up in less severe cases, prioritizing conservative treatment before considering surgery [8].

While X-ray diagnosis is the norm, NASS guidelines indicate that in cases of suspected neural compression or associated discopathies, MRI may be indicated to provide additional information on disc and nerve involvement [7].

Conservative treatment, including physical therapy, orthopedic braces, and postural adjustments, is widely recommended in the early stages and for smaller curvatures, generally under 55º. SBC emphasizes the importance of regular monitoring and non-surgical interventions to prevent deformity progression, especially in growing adolescents [6]. The effectiveness of orthopedic braces has been well documented, being most effective when started early, while the skeleton is still developing [20]. NASS also recommends braces for adolescents with progressive kyphosis but stresses that if the curvature exceeds 75º or if there is persistent pain, surgery should be considered [7].

ESS agrees that conservative treatment is the first-line option for mild cases but stresses the need for continuous follow-up to evaluate treatment efficacy and deformity progression. Physical therapy is considered an important adjunctive approach, especially for improving flexibility and muscle strengthening, helping maintain proper posture [8]. Recently, some European studies have investigated the effectiveness of stretching and strengthening exercise programs, showing positive results in reducing pain and increasing spinal mobility [21].

Surgery is indicated for more severe cases, usually when the curvature exceeds 70º to 75º, or when there is disabling chronic pain and significant functional impairment. SBC guidelines state that in cases of rigid or progressive deformity, surgery may be indicated early, especially for patients with severe curvatures or failure of conservative treatment [6]. Surgical approaches may be performed anteriorly, posteriorly, or with combined techniques, with the choice based on the severity of the deformity, the rigidity of the curvature, and the surgeon's preferences [22].

NASS recommends more aggressive surgical treatment, including spinal fusion and pedicle screw fixation, in cases with curvatures above 75º or when conservative treatment fails after an adequate monitoring period [7]. Furthermore, NASS suggests that intraoperative neurophysiological monitoring may be crucial to avoid neurological injury during correction procedures [7].

ESS adopts a more cautious approach, suggesting that surgery be considered only when conservative options prove ineffective or when the curvature stabilizes with a risk of complications. Although surgery is well-documented as effective, ESS highlights that it is associated with higher risks, including infection, loss of mobility, and pseudoarthrosis [8]. The combination of anterior and posterior fusion, though more effective for rigid deformities, can have higher complication rates, such as residual deformity and nerve damage [23].

Conclusion

SK remains a significant clinical challenge, with different approaches and recommendations depending on the region. While conservative treatment remains the first line in many cases, indications for surgery have become more refined, based on technological advancements and a better understanding of the disease's pathogenesis. The integration of SBC, NASS, and ESS guidelines provides a solid foundation for treating SK, but there are still gaps that can be filled with future research. The goal should always be to individualize treatment, considering the severity of the deformity, the response to conservative treatment, and the potential for disease progression.

Conflict of Interests

The authors have no conflict of interests to declare

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